AVIRAL CLASSES

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CHEMISTRY
CRASH COURSE

LECTURE - 05

TOPICS : Equilibrium I and II

1. In which one of the follwing reactions, K_p is less than K_e ?

   (a) $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$

   (b) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

   (c) $PCl5_{(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

   (d) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

2. The equilibrium constants for the reaction,.

   $Zn_{(s)} + Cu^{2+}_{(aq)} \rightleftharpoons Zn^{2+}_{(aq)} + Cu_{(s)}$ and

   $Cu_{(s)} + 2Ag^{+}_{(aq)}) \rightleftharpoons Cu^{2+}_{(aq)} + 2g_{(s)}$

   are K_1 and K_2 respectively. Then the equailibrium constant for the reaction,

   $Zn_{(s)} + 2Ag^{+}_{(aq)} \rightleftharpoons Zn^{2+}_{(aq)} + 2A_{(s)}$ will be

   (a) $K_1 + K_2$ (b) $K_1 \times K_2$

   (c) K_1/K_2 (d) $K_1 - K_2$

3. For the system $Ag_{(g)} + 2B_{(g)} \rightleftharpoons C_{(g)}$, the equilibrium concentrations are

   $A = 0.06$ mol L^{-1}, $B = 0.12$ mol L^{-1}, $C = 0.216$ mol L^{-1} The K_{eq} for the reactions is

   (a) 250   (b) 416

   (c) 4×10^{-3} (d) 125

4. If 0.2 mol of $H_{2(g)}$ and 2.0 mol of $S_{(s)}$ are mixed in a 1 dm^3 vessel at 90°C, the partial pressure of $H_2S_{(g)}$ formed according to the reaction

   $H_{2(g)} + S_{(s)} \rightleftharpoons H_2S_{(g)}$, ($K_p=6.8 \times 10^{-2}$) would be

   (a) 0.19 atm   (b) 0.38 atm

   (c) 0.6 atm   (d) 0.072 atm

5. Which one of the following mixtures will give a solution with pH greater than 7 ?

   (a) 50mL of 0.1 M HCL + 50 mL of 0.2 M NaCl

   (b) 50mL of 0.1 M HCL + 50 mL of 0.1 M CH_3COONa

   (c) 50mL of 0.1 M CH_3COOH + 50 mL of 0.1 M NaoH

   (d) 50mL of 0.2 M H_2SO_4 + 50 mL of 0.3 M NaOH

6. 40 mL of 0.1 m ammonium hydroxide is mixed with 20 mL of 0.1 M HCL.What is the pH of the mixture?(pK_b of ammonia solution is 4.74)

   (a) 4.74   (b) 2.26

   (c) 9.26   (d) 5

7. What is the decreasing order strength of the bases

   $OH^-, NH_2H - C \equiv C^-$ and $C \equiv C^- > OH^-$

   (a) $CH_3CH_2^- > NH_2^- > H - C \equiv C^- > OH^-$

   (b) $H - C \equiv C^- < CH_3 - CH_2^- > NH_2^- > OH^-$

   (c) $OH^- > NH_2^- > H - C \equiv C^- > CH_3CH_2^-$

   (d) $NH_2^- > H - C \equiv C^- > OH^- > CH_2CH_2^-$

8. If S_1, S_2, S_3 and S_4, are the solubilities of AgCl inn water, in 0.01 M $CaCl_2$, in 0.01 M Nacl and in 0.05 M $AgNO_3$ respectively at a certain temperature, the correct order of solubilities is

   (a) $S_1 > S_2 > S_3 > S_4$ (b) $S_1 > S_3 > S_2 > S_4$

   (c) $S_1 > S_2 = S_3 > S_4$ (d) $S_1 > S_3 > S_4 > S_2$

9. The pH of an aqueous solution of CH3COONa of concentrated C (M) is given by

   (a) $7 - \frac{1}{2}pK_a + \frac{1}{2}\log C$

   (b) $\frac{1}{2}pK_\omega + \frac{1}{2}pK_b + \frac{1}{2}\log C$

   (c) $\frac{1}{2}pK_\omega - \frac{1}{2}pK_b - \frac{1}{2}\log C$

   (d) $\frac{1}{2}pK_\omega + \frac{1}{2}pK_b + \frac{1}{2}\log C$

10. A buffer solution contains 0.1 mole of sodium acetate dissolved in 1000cm³ of 0.1M acetic acid.To the above buffer solution,0.1 mole sodium acetate is further added an dissolved.The pH of the resulting

   (a) pK_a (b) $pK_a + 2$

   (c) $pK_a - \log 2$ (d) $pK_a + \log 2$

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CHEMISTRY
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LECTURE - 5

TOPICS : Equilibrium I and II (SOLUTION)

1.   **(b) :** $K_p = K_c(RT)^{\Delta n_g}$, $K_p < K_c$ when Δn_g is negative.

2.   **(b) :** K = product of equilibrium constants of step reactions.

3.   **(a) :** $K = \dfrac{[C]}{[A][B]^2} = \dfrac{0.216}{0.06 \times (0.12)^2} = 250$

4.   **(b) :** Suppose x moles of H_2S have formed, then at equilibrium, $[H_2] = (0.2 - x)$, $[H_2S] = x$

$$p_{H_2} = \frac{0.2 - x}{0.2 - x + x} = \frac{0.2 - x}{0.2} \times P$$

$$p_{H_2S} = \frac{x}{0.2 - x + x} = \frac{x}{0.2} \times P$$

$$K_p = \frac{p_{H_2S}}{p_{H_2}} \quad i.e., \quad 6.8 \times 10^{-2} = \frac{x}{0.2 - x}$$

or $0.068(0.2 - x) = x$ or $x = 0.0127$ mol
Pressure of 0.0127 mol of H_2S at 363 K in 1 L vessel,

$$P = \frac{nRT}{V} = \frac{0.0127 \times 0.0821 \times 363}{1} = 0.38 \text{ atm}$$

5.   **(c) :** All except (c) will be acidic.

6.   **(c) :** Since, ammonium hydroxide is 50% neutralised, hence [Salt] = [Base]

$$pOH = pK_a + \log_{10} \frac{[salt]}{[base]} = 4.74 + \log_{10} 1$$

pOH = 4.74
∴   pH = 14 – 4.74 = 9.26

7.   **(a) :** The conjugate acids of the given bases are H_2O, NH_3, C_2H_2, CH_3CH_3. Their acidic strength are in the order $H_2O > C_2H_2 > NH_3 > CH_3CH_3$. A weak acid has a strong conjugate base.

8.   **(b):** 0.01 M $CaCl_2 \equiv$ 0.02 M Cl^-,

0.01 M $NaCl \equiv$ 0.01 M Cl^-,

0.05 M $AgNO_3 \equiv$ 0.05 M Ag^+

$[Ag^+][Cl^-] = K_{sp}$ (const.).

The concentration of common ion $\propto \dfrac{1}{\text{solubility}}$

9.   **(d):** pH of hydrolysed salt of strong base and weak acid is given by

$$pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$$

10.   **(d):** Number of moles of acetic acid = 0.1 mole

Total number of moles of sodium acetate present in buffer solution = 0.1 + 0.1 = 0.2 mole

$\therefore \quad pH = pK_a + \log \dfrac{[CH_3COONa]}{[CH_3COOH]}$

$\qquad\qquad = pK_a + \log \dfrac{0.2}{0.1} = pK_a + \log 2$

$\therefore \quad pH = pK_a + \log 2$