CHEMISTRY 212, Lect. Sect. 002 Name _____
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Exam #2/Tuesday, April 5, 2005 G#. _____

CLOSED BOOK EXAM—No notes or books allowed. Calculators may be used. Atomic masses of interest are included on the last page. Periodic tables are not allowed for this exam. CIRCLE ALL OF YOUR ANSWERS TO THE PROBLEMS BELOW.

1. For which of the following values of the equilibrium constant does the reaction mixture contain essentially products?

   (a) 10^{7} (b) 10^{1} (c) 10^{0} (d) 10^{-1} (e) 10^{-7}

2. If K=47.6 for $4AB \leftrightarrow 2A_2 + 4B$, then for $A_2 + 2B \leftrightarrow 2AB$, K would equal

   (a) 0.145 (b) –0.145 (c) 2.63 (d) 6.90 (e) 47.6

3. Consider the reaction system $Br_2(g) + Cl_2(g) \rightarrow 2BrCl(g)$ at a given temperature. When the system is at equilibrium, the molar concentrations of Br_2, Cl_2, and BrCl are 0.0060 M, 0.0095 M, and 0.015 M, respectively. The value of K_c for this system is .

   (a) 0.25 (b)3.9 (c) 27 (d) 53 (e) 260

4. Which of the following can we determine by using an equilibrium constant for a gaseous reaction system?

   1. the effect of changing the volume of the reaction system
   2. the extent of a reaction at equilibrium
   3. the direction of a reaction upon adding both reactants and products

   (a) 1 only (b) 2 only (c) 3 only (d) 1 and 2 only (e) 1,2, and 3

5. Carbon monoxide is toxic because it can successfully compete with oxygen for hemoglobin (Hb) sites according to the following equilibrium $\mathbf{Hb(O_2)_4 + 4CO \leftrightarrow Hb(CO)_4 + 4O_2}$. From Le Chatelier's Principle, how is CO poisoning reversed?

   (a) by increasing the O_2 pressure (b) by increasing the CO pressure
   (c) by increasing the CO_2 pressure (d) by decreasing the amount of Hb
   (e) in increasing the amount of Hb

6. Which of the following is a weak base in aqueous solution?.

   (a) H_2CO_3 (b) $B(OH)_3$ (c) N_2H_4 (d)LiOH (e) $Ba(OH)_2$

7. Each of the following pairs contains one strong acid and one weak acid **EXCEPT**?

   (a) H_2SO_4 & H_2SO_3 (b)HNO_3 & HNO_2 (c) HCl & HF (d) $HClO_4$ & $HClO_2$ (e) H_3PO_4 & H_3PO_3

8. All the following would be expected to be able to function as Lewis bases **EXCEPT**

   (a) S^{2-} (b) SH^{-} (c) Al^{3+} (d) H_2O (e) H_2S

9. Some raspberry juice has a pH of 3.40. What is its $[OH^{-}]$?

   (a) 4.0×10^{-4}M (b) 1.0×10^{-7}M (c) 2.5×10^{-9}M (d) 2.5×10^{-11}M (e) 4.0×10^{-12}M

10. Seawater has a pOH of 5.90. What is its hydroxide-ion concentration?

(a) 1.0×10^{-8}M (b) 8.0×10^{-1}M (c) 7.9×10^{-9}M (d) 1.3×10^{-6}M (e) 5.9M

11. The hydronium-ion concentration of a 0.050 M lactic acid solution is 2.62×10^{-3}. The acid dissociation constant is 1.37×10^{-4}. The pH of this lactic acid solution is?

(a) 0.42 (b) 1.30 (c) 2.58 (d) 3.86 (e) 5.94

12. Calculate the pH of a 0.017 M barium hydroxide solution.

(a) 0.034 (b) 1.47 (c) 1.77 (d) 12.13 (e) 12.53

13. What is K_a for 4-aminobenzoic acid if a 0.020 M solution of the acid has a pH of 3.31?

(a) 2.5×10^{-2} (b) 2.0×10^{-2} (c) 4.9×10^{-4} (d) 1.2×10^{-5} (e) 2.8×10^{-6}

14. A diprotic acid, H_2A, has values if $K_{a1}=1.0 \times 10^{-6}$ and $K_{a2}=1.0 \times 10^{-10}$. In a 0.10 M solution of H_2A, what is $[A^{2-}]$?

(a) 0.10 M (b) 0.2 M (c) 3.2×10^{-4} M (d) 3.2×10^{-6} M (e) 1.0×10^{-10}M

15. Which of the following mixtures is suitable for making buffers?

1. H_3PO_4 and NaH_2PO_4
2. Na_2CO_3 and $NaHCO_3$
3. NH_4Cl and NH_3

(a) 1 only (b) 2 only (c) 3 only (d) 1 & 2 only (e)1, 2, & 3

16. For an acetic acid-sodium acetate buffer solution to have a pH of 4.97, what molar ratio of CH_3COOH to $NaCH_3COO$ is needed (K_a for CH_3COOH is 1.8×10^{-5})?.

(a) 0.60 (b) 0.80 (c) 1.2 (d) 1.7 (e) 2.0

17. What is the net ionic equation for the reaction that occurs when hydrochloric acid is added to the NaHCOO/HCOOH buffer?

(a) $H^+ + H_2O \rightarrow H_3O^+$
(b) $H^+ + OH^- \rightarrow H_2O$
(c) $HCl + OH^- \rightarrow H_2O + Cl^-$
(d) $HCl + HCOO^- \rightarrow HCOOH + Cl^-$
(e) $H^+ + HCOO^- \rightarrow HCOOH$

18. Which of the following salts when added to pure water will cause a significant change in the pH of the solution?

1. $LiHSO_4$ 2. Na_2O 3. KBr

(a) 1 only (b) 2 only (c) 3 only (d) 1 & 2 only (e)1, 2, & 3

19. Which of the following is the most effective buffer system for a pH value of 4.45?

(a) H_2CO_3/HCO_3^- ($K_1 = 4.4x10^{-7}$)
(b) HCO_3^-/CO_3^{2-} ($K_2 = 4.7x10^{-11}$)
(c) H_2S/HS^- ($K_1 = 1.0x10^{-7}$)
(d) $HC_2O_4^-/C_2O_4^{2-}$ ($K_2 = 5.0x10^{-5}$)
(e) $H_3PO_4/H_2PO_4^-$ ($K_1 = 7.5x10^{-3}$)

20. A 25.00-mL sample of propionic acid, CH_3CH_2COOH, of unknown concentration was titrated with 0.104 M KOH. The equivalence point was reached when 35.31 mL of base had been added. The concentration of the original propionic acid is

(a) 0.0736 M
(b) 0.128 M
(c) 0.147 M
(d) 0.162 M
(e) 0.295 M

KEY EQUATIONS

f.p. cyclohexane=6.55°C
k_f (cyclohexane) = 20.2°C/*m*
K.E. = $mv^2/2$
$m_e = 9.11 \times 10^{-31}$ kg
$m_p = 1.673 \times 10^{-27}$ kg
$m_n = 1.675 \times 10^{-27}$ kg
K_f (water) = 1.86°C/m
K_b(water) = 0.512°C/m
J = N•m
J = C•V
e = 2.718
F = 96,500 C
N = m•kg•s^{-2}
$N_0=N_A=6.02 \times 10^{23}$ units/mol
R= 0.0821 L•atm/mol•K
R= 8.314 J/mol • K
1 L•atm = 101 J = 0.101 kJ
1 Pa = 1 kg/(m• s^2) = 1 N/m^2
1 atm = 1.01×10^5 Pa
g = 9.807 m/s^2
M = n/V
w = -PΔV
ΔU = q + w
$\Delta H°_{rxn} = \Sigma\Delta H_f^\circ(\text{products}) - \Sigma\Delta H_f^\circ(\text{reactants})$
$\Delta H_{rxn} = \Delta U_{rxn} + P\Delta V$
$\Delta H = nC_p\Delta T$
$\Delta H = c_p\Delta T$
$q = ms\Delta T$
1 Ci = 3.700×10^{10} dps
$t_{1/2}$ = 5730 years for ^{14}C

$$x_i = \left(\frac{n_i}{n_{total}}\right) = \left(\frac{P_i}{P_{total}}\right)$$

$P_i = x_iP_T$
$P_T = \Sigma P_i$

$$\log\left(\frac{P_2}{P_1}\right) = \left(\frac{\Delta H_{vap}}{2.303R}\right)\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln\left(\frac{K_2}{K_1}\right) = \left(\frac{\Delta H^0_{rxn}}{R}\right)\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$S = k_HP$
$P_A = P^o_A X_A$
$\Delta P = P^o_A X_B$
$\Delta T_b = K_bc_m$
$\Delta T_f = K_fc_m$
$\pi = MRT$

$$\ln\frac{[A]_t}{[A]_0} = -kt$$

$$\log\frac{[A]_t}{[A]_0} = -kt/2.303$$

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$t_{1/2} = 0.693/k$
$k = pfZ$
$f = e^{-Ea/RT}$

$$\text{r.m.s.} = \sqrt{\frac{3RT}{M_m}}$$

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$Q_c = \frac{[C]_i^{\,c}[D]_i^{\,d}}{[A]_i^{\,a}[B]_i^{\,b}}$$

$K_p = K_c(RT)^{\Delta n}$

$K_{reverse}=1/K_{forward}$

$$K = \frac{[H_3O^+]^2[S^{2-}]}{[H_2S]}$$

$w_{max} = -nFE_{cell}$
$E^0_{cell} = E^0_{cathode} - E^0_{anode}$
$\Delta G^0 = -nFE^0_{cell}$
$\Delta G_{rxn} = \Delta G^0_{rxn} + RTlnQ$
$\Delta G^0_{rxn} = -RT\ lnK$
$\Delta G_{rxn} = RTln(Q/K)$
$E^0_{cell} = (0.0592/n)\log K$
$E_{cell} = E^0_{cell} -(0.0592/n)\log Q$
$Q = It$
$\Delta S_{fus} = (\Delta H_{fus}/T_m)$

H 1.008	B 10.81	K 39.10	Ca 40.08
C 12.01	Br 79.90	Cl 35.45	F 19.00
N 14.00	Cr 52.00	P 30.97	Fe 55.85
O 16.00	S 32.00	Zn 65.39	Ni 58.70
Na 23.00	I 126.90		