Exam 3
CHEM 1142
Fall 2008

Name:_____

Multiple choice. Circle the best response. [3 pts. each]

Q1. Given the following slightly soluble salts and solubility-product constants, which salt would be most soluble in pure water?

a) AgCl: $K_{sp} = 1.8$ x 10^{-10} b) AgBr: $K_{sp} = 5.0$ x 10^{-15}

c) AgI: $K_{sp} = 8.3$ x 10^{-17} d) AuCl: $K_{sp} = 2.0$ x 10^{-13}

Q2. What is the correct expression for the solubility product constant for calcium phosphate?

a) $K_{sp} = [Ca^{2+}][PO_4^{3-}]$ b) $K_{sp} = [Ca^{2+}]^2[PO_4^{3-}]^2$

c) $K_{sp} = [Ca^{2+}]^2[PO_4^{3-}]^2$ d) $K_{sp} = [Ca^{2+}]^3[PO_4^{3-}]^2$ e) The correct response is not given.

Q3. Calculate the pH of a buffer prepared by mixing 0.10 mol of sodium formate and 0.05 mol of formic acid in 1.0 L of solution. [Formic Acid: HCO_2H: $K_a = 1.8$ x 10^{-4}]

a) 1.8 x 10^{-4} b) 3.44   c) 4.05   d) 5.31   e) none of these

Q4. Hypochlorite ion (OCl^-) is the conjugate base of hypochlorous acid ($HOCl$, $K_a = 3.5$ x 10^{-8}). What is the value of the base ionization equilibrium constant, K_b, for hypochlorite ion?

a) 3.5 x 10^{-22} b) 3.5 x 10^{-8} c) 2.9 x 10^{-7}

d) 2.9 x 10^7 e) 4.7 x 10^9

Q5. A buffer can be prepared by mixing:

a) a strong acid and its conjugate base.   b) a strong base and its conjugate acid.

c) a weak acid and its conjugate base.   d) a weak acid and a strong acid.

e) all responses above are correct.

Q6. The *iodide* concentration of a saturated solution of PbI_2 is 2.4 x 10^{-3} M. What is the K_{sp} for lead iodide?

a) 2.4 x 10^{-3} b) 2.9 x 10^{-6} c) 1.4 x 10^{-8}

d) 6.9 x 10^{-9} e) 1.7 x 10^{-9}

Q7. Identify the conjugate base of HPO_4^{2-} in the following reaction:

$$HCO_3^- + HPO_4^{2-} \rightleftharpoons H_2CO_3 + PO_4^{3-}$$

a) H_2O b) HCO_3^- c) H_2CO_3 d) PO_4^{3-} e) None of these.

Q8. The OH^- concentration in a 1.0×10^{-3} M $Ba(OH)_2$ solution is
a) 0.50×10^{-3} M   b) 1.0×10^{-3} M   c) 2.0×10^{-3} M
d) 0.01 M   e) 0.020 M.

Q9. Calculate the pH of a beer in which the hydrogen ion concentration is 6.3×10^{-5} M.
a) 4.20   b) 4.82   c) 5.63   d) 9.83   e) 14.04

Q10. Calculate the pH of a 6.71×10^{-2} M NaOH solution.
a) 12.83   b) 2.17   c) 11.82   d) 6.71   e) 1.17

Q11. Which one of the following salts will form an acidic solution upon dissolving in water?
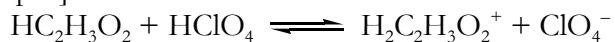a) KBr   b) NaF   c) NH_4I d) KOH   e) NaCN

Short Response. Show *all* work to receive credit.

Q12. [5 pts.] What is the pOH of a 0.025 M solution of HCl(aq) at 25 °C?

Q13. [8 pts.] A 0.065 M aqueous solution of pyruvic acid ($HC_3H_3O_3$, a weak monoprotic acid) has a pH of 3.10 at 25 °C. What is K_a for pyruvic acid?

Q14. [6 pts.] Consider the chemical reaction:
$$HC_2H_3O_2 + HClO_4 \rightleftharpoons H_2C_2H_3O_2^+ + ClO_4^-$$
Identify (and label as acid/base) both conjugate acid-base pairs.

Q15. [4 pts.] State the Lewis and Brønstëd definitions of an acid and a base.

Q16. [7 pts.] K_w is equal to 4.5 x 10^{-12} at 205 °C. What pH corresponds to a neutral solution at this temperature?

Q17. [5 pts.] Calculate the pH of a 4.2 x 10^{-4} M solution of KOH(aq).

Q18. [8 pts.] What is the molar solubility of strontium sulfate, $SrSO_4$, in 0.15 M sodium sulfate, Na_2SO_4(aq)? $K_{sp}(SrSO_4) = 2.5$ x 10^{-7}

Q19. [12 pts.] What is the pH of the solution obtained from mixing 35 mL of 0.10 M acetic acid, $HC_2H_3O_2$(aq) with 55 mL of 0.15 M sodium acetate, $NaC_2H_3O_2$(aq)? $K_a(HC_2H_3O_2) = 1.7$ x 10^{-5}.

Q20. [12 pts.] Calculate the pH of a solution obtained by mixing 10.0 mL of 0.150 M KOH(aq) with 35.0 mL of 0.135 M acetic acid, $HC_2H_3O_2$(aq). $K_a(HC_2H_3O_2) = 1.7 \times 10^{-5}$.

BONUS Questions:

A) Given the thermochemical equation:

$$C_4H_8O_2(s) + 5O_2(g) \rightarrow 4CO_2(g)+4H_2O(l); \Delta H^\circ = 3370 \text{ kJ} \cdot mol^{-1}$$
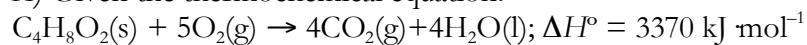
How much heat is absorbed/released when 34.2 g of $C_4H_8O_2$ reacts? Is the process exothermic or endothermic?

B) Calculate the osmotic pressure of a solution of 0.0350 M $CaCl_2(aq)$ at a temperature of 24 °C. State any assumptions you are making.

Useful Information:

$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$ at 25 °C.

$pH = -\log[H_3O^+]$

$K_aK_b = K_w$

$pH = pK_a + \log\dfrac{[Base]}{[Acid]}$

$M_1V_1 = M_2V_2$

$pH + pOH = 14.00$ (at 25 °C)

$R = 8.3145$ J/mol·K $= 0.08206$ L·atm/mol·K

$\Pi = iMRT$

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973762	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba* 137.327	71 Lu 174.967	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po [210]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

	57 La 138.9055	58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04
**	89 Ac [227]	90 Th 232.0381	91 Pa 231.03588	92 U 238.0289	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]