MC, Chem1B, Fall11, Lec Test2 Name_____

Read questions carefully before answering. No outside paper is allowed. Write **set up equation** for a mathematical problem, then put the raw data with **units**, before showing the calculation. Use the reverse side of your answer paper as scratch. Use the periodic table and important constants charts provided. (Total points = 56 + 40 + 16 = 112).

Show your calculation with set up and units (when appropriate)

1) For the equilibrium reaction given below: 1) _____

$Cu^{2+}(aq) + 4\ NH_3(aq) \leftrightarrow Cu(NH_3)_4^{2+}(aq)$

a) Write the equilibrium constant expression for this reaction (4 pts.).

To measure the equilibrium constant, 5.0 mL of 1.00 M $Cu(NO_3)_2(aq)$ solution was mixed with 15.0 mL of 1.0 M $NH_3(aq)$ at 25°C. When the equilibrium reached, the absorbance of $Cu(NH_3)_4^{2+}(aq)$ at equilibrium was determined using spectroscopy to be 0.31. A standard curve of $Cu(NH_3)_4^{2+}(aq)$, plotting the absorbance (y-axis) vs. the concentration (x-axis) gave a straight line with a slope of 1.948 and intercept of 0.0018.

b) Calculate K_c for this system at 25°C (10 pts.).

2) In the equilibrium rxn. Butane (g) ↔ Isobutane (g), assume equlibrium has reached in a 1.0 L flask with [Butane] = 0.5 M and [Isobutane] = 1.23 M at 298 K. The equlibrium constant for the reaction = 2.5 and afterwards 1.5 mol of Butane was added to the mixture. Calculate the new values of [Butane] and [Isobutane] when equilibrium was reestablished (8 pts.)? 2) _____

3) 200.0 ml of a solution containing 0.5000 moles of acetic acid per liter is added to 200.0 ml of 0.5000 M NaOH. What is the final pH? The Ka of acetic acid is 1.770×10^{-5} (10 pts) (Note: Check what components you have in the final solution.) 3) _____

4) Calculate the pH of a buffer solution that contains 0.820 grams of sodium acetate and 0.01 moles of acetic acid in 100 ml of water. The Ka of acetic acid is 1.77×10^{-5} (8 pts). 4) _____

5) Calculate the molar solubilty of CaF_2 at 25°C in a solution that is 0.010 M in $Ca(NO_3)_2$. Ksp for $CaF_2 = 3.9 \times 10^{-11}$. Show your calculation with ICE chart. (8 pts.) 5) _____

6) Calculate the concentration of iodide ions in a saturated solution of lead (II) iodide. The solubility product constant of PbI_2 is 1.4×10^{-8} (8 pts.). 6) _____

MULTIPLE CHOICE. Select the one alternative that best completes the statement or answers the question (4 pts each).

7) In a solution, when the concentrations of a weak acid and its conjugate base are equal, 7) _____
A) the system is not at equilibrium.
B) the -log of the $[H^+]$ and the -log of the K_a are equal.
C) the buffering capacity is significantly decreased.
D) all of the above are true.

8) How does the reaction quotient of a reaction (Q) differ from the equilibrium constant (K_{eq}) of the same reaction? 8) _____
A) K does not depend on the concentrations or partial pressures of reaction components.
B) Q is the same as K_{eq} when a reaction is at equilibrium.
C) Q does not depend on the concentrations or partial pressures of reaction components.
D) K_{eq} does not change with temperature, whereas Q is temperature dependent.
E) Q does not change with temperature.

9) The K_{eq} for the equilibrium below is 7.52×10^{-2} at 480 °C. 9) _____

$$2Cl_2\,(g) + 2H_2O\,(g) \rightleftharpoons 4HCl\,(g) + O_2\,(g)$$

What is the value of K_{eq} at this temperature for the following reaction?

$$2HCl\,(g) + \frac{1}{2}O_2\,(g) \rightleftharpoons Cl_2\,(g) + H_2O\,(g)$$

A) 13.3
B) 0.274
C) 3.65
D) -0.0376
E) 5.66×10^{-3}

10) For the endothermic reaction 10) _____

$$CaCO_3\,(s) \rightleftharpoons CaO\,(s) + CO_2\,(g)$$

Le Châtelier's principle predicts that _____ will result in an increase in the number of moles of CO_2.
A) removing some of the $CaCO_3$ (s)
B) decreasing the temperature
C) increasing the temperature
D) increasing the pressure
E) adding more $CaCO_3$ (s)

11) The equlibrium reaction $Co(H_2O)_6^{2+}$ (aq) (Pink) + 4 Cl^- (aq) <-> $CoCl_4^{2-}$ (aq) (Blue) + 6 H_2O(l) turns pink when placed in ice water mixture but turns blue in hot water. The reaction, as shown, is: 11) _____

A) Nonthermic
B) Endothermic
C) Exothermic
D) Insufficient data

12) In which of the following aqueous solutions would you expect AgBr to have the lowest solubility? 12) _____

A) 0.10 M $AgNO_3$
B) 0.15 M KBr
C) 0.10 M LiBr
D) 0.20 M NaBr
E) pure water

13) The pH of a solution prepared by mixing 50.0 mL of 0.125 M KOH and 50.0 mL of 0.125 M HCl is _____. 13) _____

A) 8.11 B) 5.78 C) 7.00 D) 0.00 E) 6.29

14) Which one of the following pairs <u>cannot</u> be mixed together to form a buffer solution? 14) _____

A) $NaC_2H_3O_2$, HCl ($C_2H_3O_2^-$ = acetate)
B) NH_3, NH_4Cl
C) KOH, HF
D) H_3PO_4, KH_2PO_4
E) RbOH, HBr

15) Which below best describe(s) the behavior of an amphoteric hydroxide in water? 15) _____

A) With conc. aq. HCl, its clear solution forms a precipitate.
B) With conc. aq. NaOH, its suspension dissolves.
C) With both conc. aq. NaOH and conc. aq. HCl, its suspension dissolves.
D) With conc. aq. HCl, its suspension dissolves.
E) With conc. aq. NaOH, its clear solution forms a precipitate.

16) Given K_{sp} for $Zn_3(PO_4)_2$ (s) is 9.0×10^{-33} and that K_f for $[Zn(OH)_4]^{2-}$ is 4.6×10^{17} for the formation of the complex from Zn^{2+} and OH^-, calculate the K_{net} for the following reaction: 16) _____

$Zn_3(PO_4)_2$ (s) + 12 OH^- (aq) -----> 3 $[Zn(OH)_4]^{2-}$ (aq)+ 2 PO_4^{3-} (aq).

A) 8.76×10^{20} B) 8.76×10^{-16} C) 4.14×10^{15} D) 4.14×10^{-15}

TRUE/FALSE. Circle 'A' if the statement is true and 'B' if the statement is false (2 pts each) and then provide a short explanation (2 pts. each).

17) The solubility product of a compound is numerically equal to the product of the concentration of the ions involved in the equilibrium, each multiplied by its coefficient in the equilibrium reaction. T or F

18) The solubility of slightly soluble salts containing basic anions is proportional to the pH of the solution. T or F

19) At constant temperature, reducing the volume of a gaseous equilibrium mixture causes the reaction to shift in the direction that increases the number of moles of gas in the system. T or F

20) The effect of a catalyst on a chemical reaction is to react with product, effectively removing it and shifting the equilibrium to the right. T or F

Show your calculation with set up and units (when appropriate)

21) **Extra point question:** Show your calcualtion to predict if a precipitate will form when 0.10 L of 8.0×10^{-3} M $Pb(NO_3)_2$ is added to 0.40 L of 5.0×10^{-3} M Na_2SO_4 solution. Ksp of PbSO $= 6.3 \times 10^{-7}$. Calculate $[Pb^{2+}]$ in the mixture (2 pts.) calculate $[SO_4^{2-}]$ in the mixture (2 pts.); calculate Q (2 pts.); state reason if precipitate will form or not (2 pt.). (Total 8 pts.)

21) _____

PERIODIC TABLE OF THE ELEMENTS

	1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 H 1.0079	2 2A																2 He 4.0026
2	3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
3	11 Na 22.990	12 Mg 24.305	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
4	19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57 - 71 La-Lu	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 -103 Ac-Lr	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Uuu (272)	112 Uub (285)		114 Uuq (289)				

Lanthanide	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
Actinide	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	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)	103 Lr (262)

Some Constants & Conversion Factors:

(1) Avogadro number: $N = 6.022 \times 10^{23}$/mole

(2) Planck's constant: $h = 6.626 \times 10^{-34}$ J.sec

(3) Gas Constant: R = 0.0821atm L/mol K or R = 8.3145J/mol K

(4) Speed of Light: $c = 2.997 \times 10^{8}$ m/sec

(5) Electronic Charge: $e = 1.602 \times 10^{-19}$ Coulomb

(6) π $\pi = 3.14159$

(7) 1 joule = 1 kg. m^2/s^2 = 0.239 calorie = (1 coulomb) x (1 volt); (8) 1 calorie = 4.184 joules

(9) Faraday's Constant: $F = 9.648 \times 10^{4}$ coulomb /mol electron;

(10) 1 pascal = 1 Newton / m^2 = 1 kg/m.s^2; (11) 1 atm = 760mm Hg = 760 torr

(12) K = °C + 273.15 °C; (13) °C /5 = (°F – 32) / 9

(14) 1 m = 100 cm; (15) 1 nm = 10^{-9} m; (16) 1 pm = 10^{-12} m; (17) 1 L = 1000 cm^3

(18) 1 kg = 10^{3} g; (19) 1 g = 10^{3} mg; (20) 1lb = 453.6g.