Exam Six **CHM 205 (Dr. Mattson)** **22 April 2005**	***Academic Integrity Pledge:*** *In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.* *Signature:*

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. BOX YOUR ANSWERS!

1. (4 pts) Write the formula for the following measures of solution concentration. Use m_A to represent the mass of A, and n_A for moles of A. Instead of "A", you should write in "solute", "solvent" or "solution." Use $V_{sol'n}$. for volume of solution.

(a) molarity

(b) molality

(c) mole fraction

(d) mass percent

2. A solution is prepared by dissolving 68 g $Cu(NO_3)_2$ (MM = 187.6 g/mol) in 235 g water. Calculate:

(a) (2 pts) the mole fraction of $Cu(NO_3)_2$

(b) (2 pts) the mass percent $Cu(NO_3)_2$

(c) (2 pts) the molality of $Cu(NO_3)_2$

3. (3 pts) Concentrated nitric acid is 15.8 M and has a density of 1.42 g/mL. What is the mole fraction HNO_3? [Given: MM HNO_3 = 63 g mol^{-1}]

4. (3 pts) Calculate the freezing point of a solution prepared by dissolving 85.0-g of table sugar, a non-electrolyte in 250.0 mL water. [Given: MM_{sugar} = 342 g/mol; d_{H_2O} = 1.00 g/mL; k_f = 1.86 deg/molal].

5. (3 pts) Suppose a substance of unknown identity with a mass of 7.10 g were dissolved in 40.0 g water. If the solution froze at –1.60 ^oC, determine the molar mass of the unknown, assuming it is a non-electrolyte.

6. (3 pts) The normal vapor pressure of the solvent methylene chloride is 427 mmHg at 298 K. What is the vapor pressure of this solvent if 3.0 moles of the solvent contained 0.37 moles iodine, I_2?

7. (2 pts) Which of the following solutions would have the largest osmotic pressure?
   (A) 0.10 M KCl
   (B) 0.20 M HCl
   (C) 0.24 M CH_3NO_2 (non-electrolyte)
   (D) 0.09 M $Mg(NO_3)_2$

Standard Reduction Potentials, E^o (V)	
$Ag^+ + e^-$ ⇌ Ag	+0.80
$Fe^{+3} + e^-$ ⇌ Fe^{+2}	+0.77
$I_2(s) + 2\ e^-$ ⇌ $2\ I^-$	+0.54
$Cu^{+2} + 2\ e^-$ ⇌ Cu	+0.34
$Pb^{+2} + 2\ e^-$ ⇌ Pb	-0.13
$Sn^{+2} + 2\ e^-$ ⇌ Sn	-0.14
$Ni^{+2} + 2\ e^-$ ⇌ Ni	-0.26
$Co^{+2} + 2\ e^-$ ⇌ Co	-0.28
$Fe^{+2} + 2\ e^-$ ⇌ Fe	-0.44
$Cr^{+3} + 3\ e^-$ ⇌ Cr	-0.74
$Zn^{+2} + 2\ e^-$ ⇌ Zn	-0.76
$Mg^{+2} + 2\ e^-$ ⇌ Mg	-1.66

8. (8 pts) Multiple Choice

(a) Which of these is the best reducing agent?

(A) Ag (B) Ag^+ (C) Cr (D) Zn^{+2}

(b) Which of these is most easily reduced?

(A) Zn (B) Cr^{+3} (C) Ag (D) Fe^{+3}

(c) The cobalt(II) ion will react spontaneously with

(A) Fe^{+2} (B) Pb^{+2} (C) Cu (D) Cr

(d) E^o for Ni|(Ni^{+2}, 1.0 M)||(Co^{+2}, 1.0 M)Co is

(A) +0.02 v (B) -0.02 v (C) –0.54 v (D) +0.54 v

(e) E^o for Cr|(Cr^{+3}, 1.0 M)||(Ag^+, 1.0 M)Ag is

(A) +0.06 v (B) +3.74 v (C) +1.54 v (D) +1.66 v

(f) Copper will react spontaneously with

(A) Pb (B) Zn^{+2} (C) Ag^+ (D) Cu^{+2}

(g) The reducing agent in the following equation is

$IO_3^-(aq) + 3\ SO_3^{2-}(aq)$ ⇌ $I^-(aq) + 3\ SO_4^{2-}(aq)$

(A) IO_3^- (B) SO_3^{2-} (C) I^- (D) SO_4^{2-}

(h) What oxidizing agent can be used to selectively oxidize nickel to Ni^{+2} but will not oxidize the copper to copper(II)?

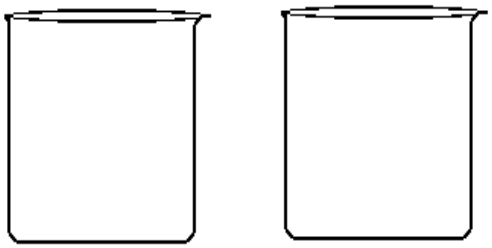
(A) Pb (B) Fe^{2+} (C) Ag^+ (D) Sn^{2+}

9. Use the beakers provided (top of next column) to sketch the Galvanic cell:

$Ni|Ni^{+2}(1\ M)||Ag^+(1\ M)|Ag.$

(a, 1pt) Make the left cell the anode and the right cell the cathode. (b, 1 pt) Add the appropriate number of anions to each beaker — assume both solutions were prepared from the nitrate salts of the metal cations. (c, 1 pt) Sketch electrodes, salt bridge, and connecting wire. (d, 1 pt) Label both electrodes with "Ag", etc., and (e. 1 pt) indicate the direction of flow of electrons through the wire and direction of flow of ions through the salt bridge.

9f (2 pts) Write the balanced net ionic reaction.



10. (a) (2 pts) Calculate E^o for the cell described in Question 9.

(b) (3 pts) Calculate E for the cell if $[Ag^+] = 0.51$ M and $[Ni^{+2}] = 1.8$ M.

11 (a) (3 pts) Calculate ΔG^o for the reaction:

$Co^{+2}(aq) + Ni(s)$ ⇌ $Co(s) + Ni^{+2}(aq)$

(b) (3 pts) What is the equilibrium constant, K_c?

12. (BONUS 1 point) Print your name here:

13. (BONUS #2 1 point) Turn in your 3 x 5 note card with your exam. Note: This bonus and the previous name bonus are available to everyone. The points offset any point deductions made on the exam.

(For DocM's use)

Your exam score (50 possible): _____

Bonus pts: Max: _____ Earned: _____

Total Score (50 maximum) _____

Determine your grade:
A ≥ 46.5; B+ ≥ 43.5; B ≥ 41.0;
C+ ≥ 37.5; C ≥ 34.00; D ≥ 30.00

Answers

1.
(a) molarity = $n_{solute}/V_{solution}$

(b) molality = $n_{solute}/m_{solvent}$(in kg)

(c) mole fraction = $n_{solute}/(n_{solvent} + n_{solute})$

(d) mass percent = 100% x $m_{solute}/(m_{solvent} + m_{solute})$

2.
(a) 0.027

(b) 22.4%

(c) 1.54 mol/kg

3. 0.401

4. -1.85 ^{o}C

5. 206.3 g/mol

6. 380 mmHg

7. B

8. C, D, D, B, C, C, B, D

9f. $Ni + 2\ Ag^{+}$ ⇆ $Ni^{+2} + 2\ Ag$

10. 1.06 v

(b) 1.04 v

11 ΔG = 3860 J

(b) Kc = 0.211