Exam Five **Chm 205 (Dr. Mattson)** **24 April 2009**	***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 <u>how</u> you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in box and then attach the periodic table. BOX YOUR ANSWERS! Write legibly.

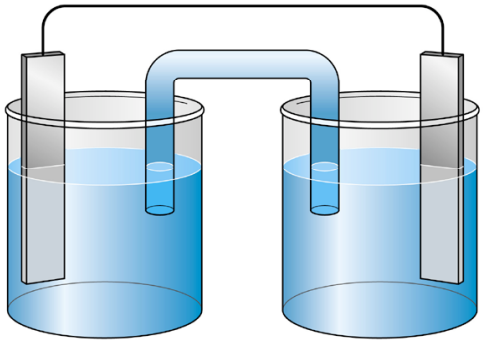
1. (5 pts) Balance the following redox reaction in acidic solution.

$$BrO_4^- + NH_4^+ \rightarrow Br_2 + NO_2$$

2. Consider the following redox reaction:

$$Sn + 2\ Ag^+ \rightarrow Sn^{+2} + 2\ Ag \quad E^o = +0.94\ V$$

2(a) (4 pts) Label the electrodes and solutions with the following labels: "Sn," "Sn^{+2}," "Ag," and "Ag^+." Assume that the anion in both cells and the salt bridge is nitrate. *<u>Make the left cell the anode and the right cell the cathode.</u>*



2(b) (3 pts) Indicate the direction of electron flow in the wire and of ion flow in the solution.

2(c) (2 pts) In which cell is the concentration of metal ions increasing? Circle: Anode or Cathode

2(d) (2 pts) In which cell is the mass of the electrode increasing? Circle: Anode or Cathode

2(e) (4 pts) Write the reaction using cell notation assuming all concentrations are 1.0 M

2(f) (2 pts) What is ΔG^o for this reaction?

A. $\Delta G^o > 0$ B. $\Delta G^o = 0$

C. $\Delta G^o < 0$ D. cannot predict

2(g) (2 pts) What is the value for n in this reaction?

A. one B. two C. three D. four

3. Given these two reduction half reactions:

$Ni^{+2} + 2\ e^- \rightarrow Ni \quad E^o = -0.26\ V$

$Co^{+2} + 2\ e^- \rightarrow Co \quad E^o = -0.28\ V$

3(a) (2 pts) Which is the most easily reduced?

A. Ni^{+2} B. Ni C. Co^{+2} D. Co

3(b) (2 pts) Which is the most easily oxidized?

A. Ni^{+2} B. Ni C. Co^{+2} D. Co

3(c) (4 pts) Write this as a balanced redox reaction:

Co| Co^{+2} (1.0 M)| |Ni^{+2} (1.0 M)| Ni

3(d) (4 pts) What is E^o for this reaction?

3(e) (4 pts) What is K_c for this reaction?

3(f) (4 pts) What is ΔG^o, in kJ, for this reaction?

3(g) (5 pts) Use the Nernst equation to calculate E if $[Co^{+2}] = 0.040$ M and $[Ni^{+2}] = 1.0$ M

4. (5 pts) How long would it take, in seconds, to electroplate 0.10 mol gold from a solution of Au^{+3} using a current of 50 amps?

5(a) (2 pts) Write the electron configuration for Co^{+2}.

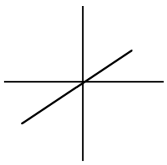
5(b) (2 pts) What +3 ion has electron configuration [Ar] $4s^0\ 3d^3$?

6. (4 pts) Which ion is the smallest ion in each set?

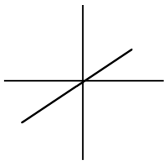
(a) Cr^{+2} Cr^{+3} Cr^{+6}

(b) Fe^{+2} Co^{+2} Ni^{+2}

7(a) (3 pts) Sketch the *cis* isomer of $Mn(Cl)_2(Br)_4^{-2}$.



7(b) (3 pts) Sketch the *fac* isomer of $Mn(Cl)_3(Br)_3^{-4}$.



8. (4 pts) Carbon monoxide has the Lewis dot structure :C:::O: and is known to function as a ligand. Use formal charges to determine if the carbon or the oxygen end of the molecule donates the electron pair to the metal cation.

Conclusion: _____ donates an E group to metal.

9. (9 pts) Use Lewis dot structures to predict whether or not these could serve as ligands.

PH_3	SiH_4	SH_2
Ligand? Yes No	Ligand? Yes No	Ligand? Yes No

10. (6 pts) Determine the oxidation state on the metal atom in each of these complexes.

$Co(NH_3)_4(Br)_2$
$K_3[Fe(CN)_6]$
$[Cr(NH_3)_6]SO_4$

11. (2 pts) Is $[Cr(NH_3)_6]SO_4$diamagnetic or paramagnetic? Circle: *diamagnetic paramagnetic*

12. (2 pts) Ethylene diamine has the formula $NH_2CH_2CH_2NH_2$. This ligand

A. connects two metal cations together.

B. only coordinates in a *trans* arrangement.

C. is a bidentate chelate.

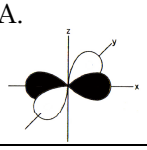
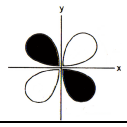
D. is associated with tetrahedral geometries.

13. (3 pts) Match description and picture

_____ The orbital called $d_{x^2-y^2}$

_____ The orbital called d_{z^2}

_____ One of three similar orbitals including d_{yz}

A.	B.	C.
		

14. (4 pts) Write balanced nuclear equations for the following processes:

14(a) α-emission of

$^{210}_{85}At$

14(b) β-emission of

$^{199}_{79}Au$

15. (3 pts) The half life of indium-111, a radioactive isotope used in studying the distribution of white blood cells, is $t_{1/2} = 2.805$ days. Approximately what percent of the isotope remains after 6 days?

(a) 10% (b) 20% (c) 33% (d) 50% (e) >50%

Print your name in the box.

Name: (only if you answer yes below): _____

Work to be graded on this sheet?

YES: If you have done work to be graded on this sheet, you must submit it with your exam and include your name above. Do not clip it to the exam — simply hand them in together.

NO: If there is nothing to grade on this sheet, simply return it to the pile next to the exams.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.01																1 H 1.01	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 97	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Ti 204.37	82 Pb 207.2	83 Bi 208.98	84 Po 209	85 At 210	86 Rn 222
87 Fr 223	88 Ra 226.03	89 Ac 227															

Useful equations:

$$E = E^o - \frac{0.0592}{n}\log Q$$

$$E^o = \frac{0.0592}{n}\log K$$

$$\Delta G = -nFE$$

$$\Delta G^o = -nFE^o$$

$$F = 96500\ C/mol = 96500 J/molV$$

$$Charge(coul) = Current(amps) \times time(s)$$

$$1\ faraday = 1\ mol\ e^- = 96500\ coul$$

Answers:

1. $2\ BrO_4^- + \ 2\ NH_4^+ \rightarrow \ Br_2 + \ 2\ NO_2 \ + \ 4\ H_2O$

2(a) Left beaker should be labeled: "Sn,"and "Sn^{+2}" The beaker on the right labeled "Ag" and "Ag^+"

2(b) Electrons are flowing left to right through the wire and anions are flowing right to left through salt bridge.

2(c) Anode

2(d) Cathode

2(e) $Sn\,|\,Sn^{+2}(1\ M)\,|\,|\ Ag^+(1\ M)\,|\,Ag$"

2(f) $\Delta G^o < 0$

2(g) two

3(a) Ni^{+2}

3(b) Co

3(c) $Ni^{+2} + Co \rightarrow Ni + Co^{+2}$

3(d) E^o +0.02 v

3(e) $K_c = 4.74$

3(f) $\Delta G^o = -3.86$ kJ

3(g) E = 0.06 v

4. 579 s

5(a) [Ar] $4s^0\ 3d^7$

5(b) Cr^{3+}

6. (a) Cr^{+6} (b) Ni^{+2}

7(a) two chlorides 90 degrees apart

7(b) three chlorides 90 degrees apart

8. The carbon has a formal charge = -1 and oxygen +1. Donates through electron-rich carbon.

9. (a) PH_3 is AB_3E, therefore a ligand (b SiH_4 is AB_4, therefore not a ligand (c) PH_3 is AB_2E_2, therefore a ligand

10. +2, +3, +2

11. paramagnetic

12. C

13. A, C, B

14. (a) ${}^{210}_{85}At \rightarrow {}^{4}_{2}\alpha + {}^{206}_{83}Bi$ (b) ${}^{199}_{79}Au \rightarrow {}^{0}_{-1}\beta + {}^{199}_{80}Hg$

15. (b) 20%