**CH302 Spring 2009 Worksheet 7 on Electrochemistry**

Use the following table of standard reduction potentials:
http://www.jesuitnola.org/upload/clark/refs/red_pot.htm

1. Consider the redox reaction: $Cd(s) + Co^{3+}(aq) \rightarrow Cd^{2+}(aq) + Co^{2+}(aq)$
   a. Balance it

   b. Calculate $E°_{cell}$

2. Consider the redox reaction: $Fe^{2+}(aq) \rightarrow Fe(s) + Fe^{3+}(aq)$
   a. Balance it

   b. Calculate $E°_{cell}$

3. Consider the redox reaction: $VO^{2+}(aq) + MnO_4^-(aq) \rightarrow MnO_2(s) + VO_2^+(aq)$
   a. Balance it in acid

   b. Balance it in base

   c. Calculate $E°_{cell}$

4. Consider the redox reaction: $BiO^+(aq) + 2Cr^{3+}(aq) \rightarrow Bi(s) + Cr_2O_7^{2-}(aq)$
   a. Balance it in acid

   b. Balance it in base

   c. Calculate $E°_{cell}$

5. What effect will raising the pH have on $E°_{cell}$ for
   a. the reacion in question 3 above?

   b. the reacion in question 4 above?

6. Consider the answer to 1b above, If $[Co^{3+}]$ and$[Co^{2+}]$ were both 1 M, what concentration of $[Cd^{2+}]$ could be used to make a 2.5 V battery based on this reaction?

7. Consider the answer to 2b above. Using the Nernst equation, what ratio of $[Fe^{3+}]$ and $[Fe^{2+}]$ would be present if this cell were allowed to reach equilibrium at room temperature?

8. If $E°_{cell}$ for a particular reaction is negative,
   a. what are two things one could do to make the $E_{cell}$ positive?

   b. what is one thing you could do to make $E°_{cell}$ positive?

9. Rank the following species from worst to best oxidizing agent: $PbSO_4$, $Na^+$, $Fe^{3+}$, $Cl_2$ and AgCl.

10. Rank the following species from best to worst reducing agent: $Mn^{2+}$, Ni, $H_2$, Al, $Hg_2^{2+}$.

11. What will be produced at the cathode
   a. for the reaction in question 1?

   b. for the reaction in question 2?

   c. for the reaction in question 3?

   d. for the reaction in question 4?

12. What will be consumed at the anode
   a. for the reaction in question 1?

   b. for the reaction in question 2?

   c. for the reaction in question 3?

   d. for the reaction in question 4?

12. Calculate ΔG
   a. for the reaction in question 1

   b. for the reaction in question 2

   c. for the reaction in question 3

   d. for the reaction in question 4

13. Calculate K
   a. for the reaction in question 1

   b. for the reaction in question 2

   c. for the reaction in question 3

   d. for the reaction in question 4

14. If a current of 1 ampere can plate 3 moles of a certain product in 10 hours,
   a. how much of the same product could it plate in 20 minutes?

   b. what current would be needed to plate 6 moles in just 2 hours?

15. If a 5.5845 g sample of Fe is plated from an unknown solution in 482 minutes at a constant current of 1 ampere, what was the oxidation state of the Fe ion is solution?

16. Complete the table below from memory

| | E | ΔG | K | Reduction | Oxidation | Cathode | Anode |
|---|---|---|---|---|---|---|---|
| Battery | | | | | | | |
| Electrolytic | | | | | | | |

17. When electroplating metal (producing a solid metal from an ion by an electrolytic reaction), the amount of metal produced is

a. directly proportional to

b. inversely proportional to

18. Using the table mentioned at the top of this document, what species could

a. reduce $O_2(g)$ to $H_2O(l)$ but not $NO_3^-(aq)$ to $NO(g)$

b. reduce $Cu^{2+}(aq)$ to $Cu^+(aq)$ but not $Pb^{2+}(aq)$ to $Pb(s)$

c. oxidize $Ag(s)$ to $Ag^+(aq)$ but not $H_2O_2(aq)$ to $O_2(g)$

19. Determine the number of electrons gained/lost by the carbon atom in each reaction below

a. $CH_4 + 2\ O_2 \rightarrow + CO_2 + 2\ H_2O$

b. $CH_4 + O_2 \rightarrow + CH_2O + H_2O$

c. $2\ CH_4 + O_2 \rightarrow + 2\ CH_3OH$

20. Consider the answer to question 19 above. How does a breaking a C-H bond and forming a C-O bond effect the oxidation state of C?