CHM 112 Chapter 17 Extra Credit: Electrochemistry Name _____

Use the standard reduction potentials listed in the appendix of your Equation sheer, textbook or Google as needed.

1. Draw the cell diagram (picture) for a galvanic cell for which the cell notation is

Fe (s) | Fe^{2+} (aq) || Ag^{+} (aq) | Ag(s)

Anode

a)Label the anode and the cathode clearly.

b) Indicate the charge on each electrode.

c) Show the direction of the flow of the electrons in the external circuit

d) Write down the balanced equation for the overall cell reaction

$Fe\ (s) + Ag^{+}\ (aq) \longrightarrow Fe^{2+} + Ag(s)$

e)Calculate $\mathcal{E}^{\circ}_{cell}$

1.24 V

2. Draw the cell diagram (picture) for a galvanic cell for which the cell notation is

Pt (s) | Sn^{4+} (aq), Sn^{2+} (aq) || MnO_4^- (aq), Mn^{2+} (aq), H^{+} | Pt(s)

Label the diagram clearly and indicate the composition of the electrolytes in the two half cells. Show the signs of the electrodes and label the cathode and the anode.

Write down a balanced equation for the overall cell reaction.

$5\ Sn^{4+}\ (aq) + 2\ MnO_4^-\ (aq) + 16\ H^{+} \longrightarrow 2\ Mn^{2+}\ (aq) + 5\ Sn^{2+}\ (aq) + 8\ H_2O\ (l)$

a) Calculate $\mathcal{E}^{\circ}_{cell}$

1.38 V

3. Using the standard reduction potentials given in Appendix of your text book, calculate the cell potential ($\mathcal{E}^{\circ}_{cell}$) at 298 K for each of the following reactions.

(A) $Br_2\ (aq) + 2\ Cl^{-}\ (aq) \rightarrow 2Br^{-}\ (aq) + Cl_2\ (g)$

-.29 V

(B) A Galvanic Cell with the SHE and Fe^{2+}/Fe(s)

.44 V

4. For the reactions listed in Question 3, calculate the Standard free energy change ΔG° at 298 K. Indicate whether the reactions are spontaneous or not.

(A) $Br_2\ (aq) + 2\ Cl^{-}\ (aq) \rightarrow 2Br^{-}\ (aq) + Cl_2\ (g)$

56 kJ

(B) A Galvanic Cell with the SHE and Fe^{2+}/Fe(s)

-85 kJ

5. Now, calculate the equilibrium constant K for the same reactions in Question 5 at 298 K.

(A) Br_2 (aq) + 2 Cl^- (aq) → 2Br^- (aq) + Cl_2 (g)

1.5 x 10^{-10}

(B) A Galvanic Cell with the SHE and Fe^{2+}/Fe(s)

7.6 x 10^{14}

6, Given the cell reaction : 2 Cl^- (aq) + Fe^{3+}(aq)→ Cl_2 (aq) + Fe^{2+}(aq) (unbalanced)

a) As written, is the cell galvanic or electrolytic?

b) Calculate $\mathcal{E}°_{cell}$.

-.59 V electrolytic

Calculate ΔG°.

+ 114 kJ

7. A voltaic cell uses the following reaction

2Al (s) + 3I_2 (s) → 2Al^{3+} (aq) + 6I^- (aq)

a) Calculate the cell potential ($\mathcal{E}°_{cell}$) under standard conditions.

2.19 V

b) Calculate the cell potential (E) when [Al^{3+}] = 0.015 M and [I^-] = 0.025 M,.

2.32 V

8. How many grams of Nickel are deposited if an electric current of 45.00 A is run through a solution of $NiSO_4$ for 40.0 minutes?

32.9 g

9. How many hours are required to produce 1.50 kg of aluminum metal from the electrolysis of molten $AlCl_3$ with an electrical current of 250. A?

17.9 hr

10. A cell was set up having the following reaction

$Mg(s) + Cd^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cd(s)$ $\quad\quad E°_{cell} = 1.97\ V$

The Magnesium electrode was dipped in a 1.00 M solution of $MgSO_4$ and the Cadmium electrode was dipped in a solution of unknown Cd^{2+} concentration. The cell potential was measured to be 1.80 V.
What is the unknown Cd^{2+} concentration?

1.8×10^{-6} M

11. The $\mathcal{E}°_{cell} = 0.135$ V for the following reaction

$3\ I_2(s) + 5\ Cr_2O_7^{2-}(aq) + 34\ H^+(aq) \rightarrow 6\ IO_3^-(aq) + 10\ Cr^{3+}(aq) + 17\ H_2O(l)$

Calculate the cell EMF at 298 K if $[Cr_2O_7^{2-}] = 0.010$ M, $[H^+] = 0.10$ M, $[IO_3^-] = 0.00010$ M and $[Cr^{3+}] = 0.0010$ M?

.155 V