Chemistry 142 Quiz 6 4/20/09

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Key\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Instructor: Martin Larter

1. Use the ion-electron method to balance the following redox reaction that occurs in ***basic*** solution. Write ***complete, balanced equations*** for the individual half reactions and for the overall net ionic equation. Also, ***circle the oxidizing agent***.

Al(s) + NO2-(aq) 🡪 AlO2-(aq) + N2H4 (aq)

**Reduction** Half Reaction:

(10 e- + 12 H+ + 2 NO2-(aq) 🡪 N2H4 (aq) + 4 H2O) x 3

**30 e- + 36 H+ + 6 NO2-(aq) 🡪3 N2H4 (aq) + 12 H2O**

**Oxidation** Half Reaction:

(2 H2O + Al(s) 🡪 AlO2-(aq) + 4 H+ + 3 e-) x 10

**20 H2O + 10 Al(s) 🡪 10 AlO2-(aq) + 40 H+ + 30 e-**

**Net Ionic** Equation:

(4OH-) + 8 H2O + 10 Al(s) + 6 NO2-(aq) 🡪10 AlO2-(aq) + 3 N2H4 (aq) +4 H+ + (4OH-)

**4OH- + 4 H2O + 10 Al(s) + 6 NO2-(aq) 🡪10 AlO2-(aq) + 3 N2H4 (aq)**

1. A voltaic cell is constructed from the following half reactions at 298 K

Ag+ +e- 🡪 Ag Eored = 0.797 V (reverse)

H2O2 +2H+ +2e- 🡪 2 H2O Eored = 1.776 V

 Eocell =0.977 V

 2 Ag + H2O2 +2H+ 🡪 2 Ag+ + 2 H2O

1. Calculate Ecell when [Ag+] =2.0, [H2O2] =1.0 M and pH=7. Does current spontaneously flow in the cell under these conditions?

Ecell = 0.977 V -0.0592\* log (2.0 M)2 = 0.55 V yes, current spontaneously flows

 2 (1.0 M)\* (1.0 x10-7 M)2

1. Qualitatively how will raising the pH of the reaction solution affect the value of Ecell and the spontaneity of the reaction?

As pH increases, hydronium concentration decreases thus the amount of reactants decreases. If we thing of this in terms of Le Chatelier principle the reaction moves to the left decreasing the spontaneity of the reaction.

1. Draw a picture of and write the short hand notation for the following voltaic cell. You will need to write the balanced half reactions first. (assume all is done under standard conditions)

HClO (aq) + Ag 🡪 Ag+ (aq) + Cl2 (g)

 Make sure to label the following items on your diagram:

 \*anode \*cathode \*positive post \*negative post

 \*direction of flow of electrons \*direction of flow of cations and anions from the salt bridge

Oxidation : 2 Ag 🡪 2Ag+ +2e- (anode) Eo = -0.799 V

Reduction: 2 HClO + 2 H+ + 2 e- 🡪2 H2O + Cl2 (Cathode) Eo = 1.63 V

 Eocell =0.831 V



Line Notation\_\_\_Ag (s)│Ag+║HClO, H+│ Cl2 (g)│Pt\_\_\_\_\_\_\_\_

1. Determine Gibbs free energy and the equilibrium constant for the reaction above.

 ∆G = -2e- \* 96500 C/mol e- \* 0.831 J/C \* 1kJ/1000 J = - 160. kJ

 Ln K = - (-1.6 x105 J/8.314 J/mol\*K\*298 K)= 1.92 x104 mol

 K= 1.11 x1028

1. Rank the following species from best to worst reducing agent: Mn2+, Ni, H2, Al, Hg22+.

**Worst**  Al Ni H2 Hg22+ Mn2+ **Best**