Chem 1105-2015 Summer Problem Set #7

1. For each of the following unbalanced redox equations balance the overall equation.

a) $C_6H_5OH(aq) + SO_3(g) \rightarrow CO_2(g) + SO_2(g)$ (acidic)

b) $SO_3^{2-}(aq) + MnO_4^-(aq) \rightarrow SO_4^{2-}(aq) + MnO_2(s)$ (basic)

c) $CrO_2^-(aq) + ClO^-(aq) \rightarrow Cl^-(aq) + CrO_4^{2-}(aq)$ (basic)

2. In question #1 assign oxidation numbers and identify the substance oxidized, reduced, the oxidizing agent, and reducing agent.

3. Make a schematic drawing of the cell shown by the cell diagram. Label all parts of the cell, indicate ion and electron flow, write a balanced half reaction equation for the reactions that takes place at each electrode, and write the reaction equation for the overall reaction.

$$Ni(s)\,|\,Ni^{2+}(aq)\,||\,Cu^{2+}(aq),\,Cu^{+}(aq)\,|\,Pt(s)$$

4. A voltaic cell containing standard Co^{2+}/Co and Au^{3+}/Au half cells is constructed and the following experimental observations are observed.

1. Metallic gold plates out on one electrode, and the gold ion concentration decreases around that electrode.

2. The mass of the cobalt electrode decreases, and the cobalt(II) ion concentration increases around that electrode.

a) Without consulting a table of standard reduction potentials, write the line notation for this electrochemical cell.

b) Diagram and completely describe the cell from the experimental observations.

5. Calculate $E°_{cell}$ for each of the following electrochemical cells at 25 °C.

a) $Ag(s)\,|\,Ag^+(aq)\,||\,Ce^{4+}(aq),\,Ce^{3+}(aq)\,|\,Pt(s)$

b) $O_2(g) + 4H^+(aq) + 4I^-(aq) \rightarrow 2I_2(s) + 2H_2O(l)$

c) $5Hg_2^{2+}(aq) + 2MnO_4^-(aq) + 16H^+(aq) \rightarrow 10Hg^{2+}(aq) + 2Mn^{2+}(aq) + 8H_2O(l)$

6. Use a table of standard reduction potentials to arrange the following species in order of decreasing strength as oxidizing agents: Fe^{3+}, $Br_2(l)$, Cu^{2+}

7. Calculate E_{cell} for each of the following electrochemical cells at 25 °C.

a) $Ga(s)\,|\,Ga^{3+}(0.0050\ M)\,||\,H^+(aq)(0.0100\ M)\,|\,H_2(g)(1\ atm)\,|\,Pt(s)$

b) $Ni(s)\,|\,Ni^{2+}(aq)(0.250\ M)\,||\,Cu^{2+}(aq)(0.500\ M),\,Cu^+(aq)(0.750\ M)\,|\,Pt(s)$

c) $Cl_2(g)(1.00\ atm) + 2Br^-(aq)(0.100\ M) \rightarrow Br_2(l) + 2Cl^-(aq)(0.50\ M)$

d) $3AgCl(s) + Al(s) \rightarrow 3Ag(s) + 3Cl^-(aq)(0.100\ M) + Al^{3+}(aq)(0.125\ M)$

8. Calculate the concentration of $H^+(aq)$ and the pH for the following electrochemical cell.

$$Ga(s)\,|\,Ga^{3+}(0.100\ M)\,||\,H^+(aq)(?)\,|\,H_2(g)(1\ atm)\,|\,Pt(s) \qquad E_{cell} = 0.467\ V$$

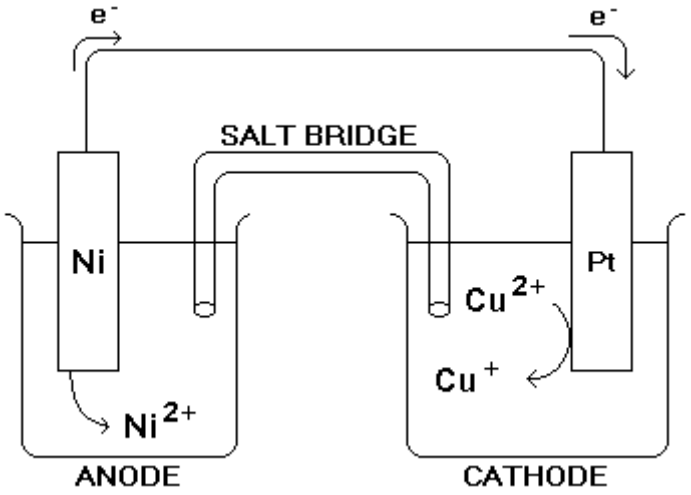
9.a) How many grams of Zn can be deposited on a steel gate if a current of 15.0 A is passed through a $ZnSO_4$ solution for 1.00 day? b) How many seconds does it take to deposit 85.5 g Zn on a steel gate when a current of 23.0 A is passed through a $ZnSO_4$ solution?

Answer Set for Chem 1105-2015 Summer Problem Set #7

1. a) $C_6H_5OH(aq) + 14SO_3(g) \rightarrow 6CO_2(g) + 14SO_2(g) + 3H_2O(l)$
b) $3SO_3^{2-}(aq) + 2MnO_4^-(aq) + H_2O(l) \rightarrow 3SO_4^{2-}(aq) + 2MnO_2(s) + 2OH^-(aq)$
c) $2CrO_2^-(aq) + 3ClO^-(aq) + 2OH^-(aq) \rightarrow 3Cl^-(aq) + 2CrO_4^{2-}(aq) + H_2O(l)$

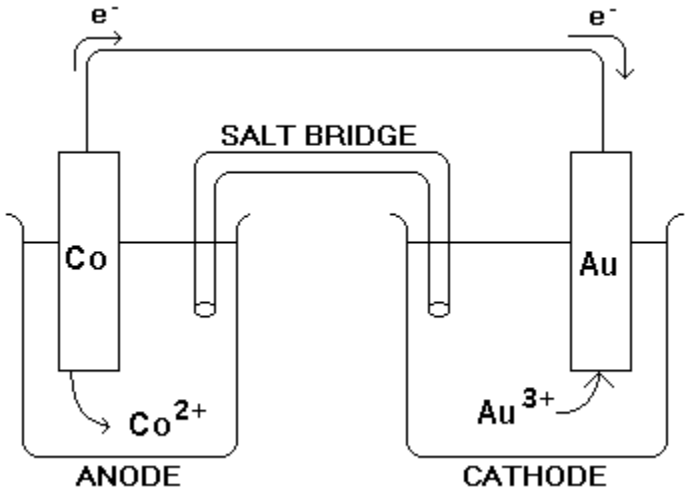
2.a) substance reduced/oxidizing agent: SO_3; substance oxidized/reducing agent: C_6H_5OH
b) substance reduced/oxidizing agent: MnO_4^-; substance oxidized/reducing agent: SO_3^{2-}
c) substance reduced/oxidizing agent: ClO^-; substance oxidized/reducing agent: CrO_2^-

3.



anode: $Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$
cathode: $Cu^{2+}(aq) + e^- \rightarrow Cu^+(aq)$
overall: $Ni(s) + 2Cu^{2+}(aq) \rightarrow Ni^{2+}(aq) + 2Cu^+(aq)$

4.a) $Co(s)\,|\,Co^{2+}(aq)\,||\,Au^{3+}(aq)\,|\,Au(s)$



5.a) 0.81 V, b) 0.6943 V, c) 0.6036 V

6. Strongest Oxiding Agent: $Br_2(l)$ > $Fe^{3+}(aq)$ > $Cu^{2+}(aq)$:Weakest Oxidizing Agent

7.a) 0.487 V, b) 0.4181 V, c) 0.2412 V, d) 1.9750 V

8.$[H^+(aq)]$ = 0.0125 M, pH = 1.90

9.a) 439 g Zn, b) 1.10×10^4 s