**Electrochemical Cells**

Consult [http://www.stolaf.edu/depts/chemistry/courses/toolkits/126/hw/table-Eo.pdf](http://www.stolaf.edu/depts/chemistry/courses/toolkits/126/hw/table-Eo.pdf) or Appendix III of *Introduction to Molecular Thermodynamics* for a table of standard reduction potentials at 25 °C.

1. Inspecting this table, answer the questions below.
   a. What is the chemical formula of the strongest oxidizing agent in this table? The weakest oxidizing agent?
   b. What is the chemical formula of the strongest reducing agent in this table? The weakest reducing agent?
   c. Combining two half reactions, write the chemical equation for the oxidation-reduction reaction that provides the largest standard cell potential using half reactions found on the table.
   d. Based on information in the table, determine which of the following metals should react spontaneously with solutions containing 1.0 M H⁺(aq) ions to form hydrogen gas: aluminum, gold, zinc, copper, nickel, silver, strontium, iron, and sodium. Briefly explain your reasoning.
   e. Based on information in the table, predict which of the following species will be reduced spontaneously by nickel metal: Mn²⁺, Co²⁺, MnO₄⁻, Cu²⁺, H⁺, Sn²⁺, and SO₄²⁻. Briefly explain your reasoning.

2. Using the information on this table, calculate $E_{\text{cell}}^\circ$ for each of the following chemical equations, and predict in each case whether the reaction as written will be spontaneous under standard conditions.
   a. $\text{Mn}(s) + \text{Mg}^{2+}(aq) \rightarrow \text{Mn}^{2+}(aq) + \text{Mg}(s)$
   b. $\text{AgCl}(s) + \text{NO}(g) \rightarrow \text{Ag}(s) + \text{Cl}^-(aq) + \text{NO}_3^-(aq)$
   c. $\text{Co}(s) + \text{Sn}^{4+}(aq) \rightarrow \text{Sn}^{2+}(aq) + \text{Co}^{2+}(aq)$

3. For each of the following equations, assuming standard conditions, (i) calculate the $E_{\text{cell}}^\circ$ values for the electrochemical cell that could be made using this reaction, (ii) write shorthand notation for the electrochemical cell, (iii) diagram the electrochemical cell indicating concentrations of ions in solution, the half-reactions taking place at the anode and cathode, and the direction of electron and ion migration, and (iv) indicated whether the reaction as written will be spontaneous under standard conditions.
   a. $\text{Cd}(s) + 2 \text{Ag}^+(aq) \rightarrow \text{Cd}^{2+}(aq) + 2 \text{Ag}(s)$
   b. $\text{Mn}(s) + 2 \text{Fe}^{3+}(aq) \rightarrow \text{Mn}^{2+}(aq) + 2 \text{Fe}^{2+}(aq)$
   c. $14 \text{H}^+(aq) + \text{Cr}_2\text{O}_7^{2-} (aq) + 2 \text{Al} (s) \rightarrow 2 \text{Cr}^{3+}(aq) + 2 \text{Al}^{3+}(aq) + 7 \text{H}_2\text{O}(l)$