

Cell Potential and Equilibrium

$$\Delta G = -nFE^\circ$$

Example

- Calculate ΔG° for the reaction:
- $\text{Cu}^{2+}(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{Fe}^{2+}(\text{aq})$

The Nernst Equation

- What happens when concentration and temperatures are not standard?
- Nernst Equation

$$E = E^\circ - \frac{0.0592}{n} \ln Q \quad \text{Assuming } 25^\circ\text{C}$$

Example

- What is the electrical potential for the following cell with the following concentrations?
- $\text{VO}^{2+} + \text{Zn} \rightarrow \text{Zn}^{2+} + \text{VO}_2^+$
- $[\text{VO}^{2+}] = 2.0 \text{ M}$
- $[\text{H}^+] = 0.50 \text{ M}$
- $[\text{VO}_2^+] = 1.0 \times 10^{-2} \text{ M}$
- $[\text{Zn}^{2+}] = 0.10 \text{ M}$

Example

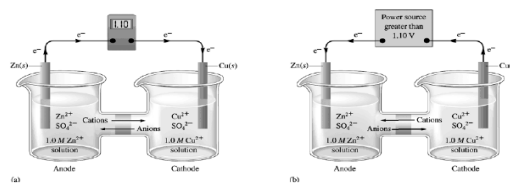
- **First: Write the balanced equation: Use the table of reduction potentials**

- **Second: find E°**

- **Third: Use the Nernst Equation and plug in the concentration values for Q**

Electrolysis

- The opposite of a galvanic cell
 - Pump electricity through a non spontaneous reaction.



A few definitions

- Electrolytic Cell

- Electrolysis

- Ampere:

- Faraday

Example 1

- Calculate the amount of time required to produce 1000 g of magnesium metal by electrolysis of molten $MgCl_2$ using a current of 50A.

Example 2

- A Cr^{3+} (aq) solution is electrolyzed, using a current of 7.60 A. What mass of Cr (s) is plated out after 2.00 days?
- What amperage is required to plate out 0.250 mol Cr from a Cr^{3+} solution in a period of 8.00 hours?

Example 3

- What reaction will take place at the cathode
- 1.0 M KF solution
- 1.0 M CuCl_2 solution
- 1.0 M H_2O_2 solution containing 1.0 M HCl

AP Style Example

- The Diagram on the next page shows the experimental setup for a typical electrochemical cell that contains two standard half-cells. The cell operates according to the reaction represented by the following equation:
- $\text{Zn(s)} + \text{Ni}^{2+}(\text{aq}) \rightarrow \text{Ni(s)} + \text{Zn}^{2+}(\text{aq})$
- a) Identify the M and M^{2+} in the diagram and specify the initial concentration for M^{2+} in solution.
- b) Indicate which of the metal electrodes is the cathode. Write the balanced equation for the reaction that occurs in the half-cell containing the cathode.
- c) What would be the effect on the cell voltage if the concentration of Zn^{2+} was reduced to 0.100M in the half cell containing the Zn electrode.
- d) Describe what would happen to the cell voltage if the salt bridge was removed. Explain.

AP Style Examples

