

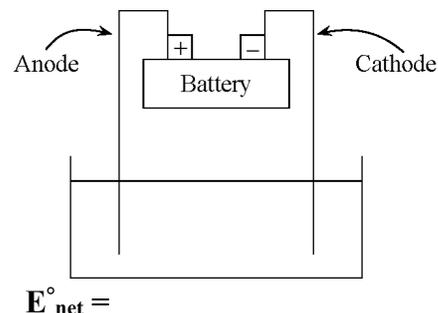
Worksheet 16-3
Electrolytic Cells

Name _____
Period _____ Date _____

- 1) The electrolysis of CuBr_2 (aq)
a) Two graphite electrodes are attached to a power source (9V) and are placed into CuBr_2 (aq).
What species are in the sol'n?

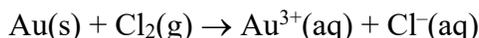
Possible oxidation half reactions	E°_{ox}	Possible reduction half reactions	E°_{red}
$2 \text{H}_2\text{O} \rightarrow \text{O}_2 + 4 \text{H}^+ + 4 \text{e}^-$	-(1.23)	$2 \text{H}_2\text{O} + 2 \text{e}^- \rightarrow 2 \text{OH}^- + \text{H}_2$	-0.83
$2 \text{Br}^- \rightarrow \text{Br}_2 + 2 \text{e}^-$	-(1.07)	$\text{Cu}^{2+} + 2 \text{e}^- \rightarrow \text{Cu}$	0.34

- b) After writing the half reactions below, go back and label the diagram with the substances observed at the anode and cathode.
c) In the diagram, label what would be observed at the anode and cathode. Label the direction of flow of electrons.
d) Determine the overall reaction below and calculate E°_{net} .



Ox: $E^\circ_{\text{ox}} =$
Red: $E^\circ_{\text{red}} =$
Overall:

- 2) A student wants to use a galvanic cell (consisting of two half cells) to spontaneously oxidize Au to Au^{3+} using Cl_2 , which he had been told was a strong oxidizing agent. Thus, the following unbalanced reaction would occur:



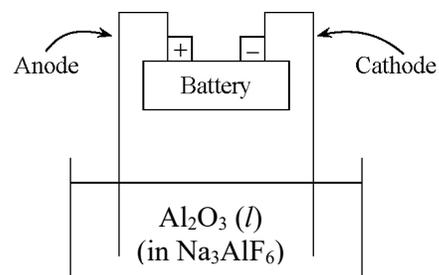
- a) Write out the oxidation and reduction half reactions and determine their voltages. Determine the balanced net reaction and the net voltage.

Ox: $E^\circ_{\text{ox}} =$
Red: $E^\circ_{\text{red}} =$
Overall: $E^\circ_{\text{net}} =$

- b) Would this reaction occur spontaneously? Explain how you know.
c) If the reaction would not occur spontaneously, how could the student make the reaction occur?

- 3) The basic reaction for the electrolysis of Al from Al_2O_3 is shown below.

- a) Write out the half reactions (split Al_2O_3 into ions and use ions in half reactions).
b) In diagram, label the flow of electrons and where Al (s) and O_2 (g) are produced.



Ox:
Red: _____

Read the article, "Friedrich Wöhler's Lost Aluminum," *Chem Matters*, October 1990, 14-15 and answer the following questions.

- 4) Unlike other common metals like iron and copper, aluminum was unknown until nearly 200 years ago. Wöhler first isolated pure aluminum metal in 1827.
- How was Al first isolated? Write the two half-reactions involved and determine the E° for the reaction. (*Note: this is a spontaneous single-replacement reaction.*)
 - Why was it difficult to isolate the aluminum and why was it so expensive (write the electrolysis reaction and half reactions, and determine the E° —remember it should be negative)?
 - Why was direct electrolysis considered impractical for aluminum compounds?
- 5) Two developments allowed aluminum to be produced cheaply (thus undercutting the market and allowing the cheap and plentiful use of the metal).
- What development occurred in 1866?
 - What process did Hall and Heroult independently develop in 1886? Be specific about the chemicals involved.