

Expt. 12: Electrochemical cells

This lab takes the place of Experiment 12 in your lab manual.

- I. Using either Chrome or Firefox, access the site at <http://web.mst.edu/~gbert/Electro/Electrochem.html>

To use this site, you will place the anode on the left and the cathode on the right. When you select your electrode for each side using the dropdown menu, you will need to select the appropriate solution to go with that electrode using the dropdown menu. You can also change the concentration of the solutions on either side by entering it in the appropriate box. The measured cell potential will appear on the multimeter in the center once you click "Measure Cell Voltage."

Record all your results and answers to the questions on the Data Pages. This will limit the number of pages you have to scan or take photographs of in order to turn in your assignment.

II. A study of electrochemical cells under standard conditions

In your original lab manual on page 110, you were supposed to fill in the table for several different electrochemical cells. You are going to test these cells under standard conditions, so all concentrations will be 1.0 M.

- A. Based on the cells shown on page 110, identify which species should be the anode and which should be the cathode in each case. Record this and your predicted standard cell potentials for each of the cells in the Data Table.
- B. Based on what you picked as the anode and cathode for each of the cells on page 110, set up those cells using the simulation. Record the experimental value you obtained in each case.
- C. Summarize the results of your tests in part B by comparing your experimental values to the theoretical values.

III. A study of concentration cells

In this section, you will set up two sets of concentration cells with each set using a different metal. You may use any of the metals in the simulation except the Pt/hydrogen and the Whodatium (the randomly generated metal). As it is not listed for the solutions in this simulation, the charges for the zinc and cadmium should both be +2.

- A. Pick a metal and set up the anode and cathode with that metal and the appropriate solution. Record the identity of the metal in your Data Table.
- B. On the right side, you will change the concentration of the solution to 0.500 M.

- C. On the left side, pick a concentration that is between 0.0100 M and 0.0500 M for the solution. Measure the cell voltage and record both the concentration and the voltage in your Data Table.
- D. On the left side, pick a concentration that is lower than 0.00100 M and measure the cell voltage again. Record both the concentration and the voltage in your Data Table.
- E. Using the Nernst equation, calculate the expected cell potential for each of your concentration cells. Make sure to take into account the appropriate number of electrons in your calculation. Show one example of your calculation and record the values in the Data Table.
- F. Pick a second metal and repeat the experiment (steps A – E) using the same concentrations as you used for the first metal.
- G. Do you notice any differences between the two metals you used? Summarize your results in the Data Table.

IV. A study of an electrochemical cell with different concentrations and different metals.

In this section, you will set up an electrochemical cell using different metals. You may use any of the metals in the simulation except the Pt/hydrogen and the Whodatum (the randomly generated metal). As it is not listed for the solutions in this simulation, the charges for the zinc and cadmium should both be +2.

- A. Pick a metal and set up the anode with that metal and the appropriate solution. Record the identity of the metal and write the appropriate half-reaction for the anode in your Data Table.
- B. Pick a second (and different) metal and set up the cathode with that metal and the appropriate solution. Record the identity of the metal and write the appropriate half-reaction for the cathode in your Data Table.
- C. Write the overall reaction for this cell in your Data Table. Make sure that you balance the number of electrons.
- D. On the right side, you will change the concentration of the solution to something between 0.500 M and 1.500 M.
- E. On the left side, pick a concentration that is between 0.00100 M and 0.00500 M for the solution. Measure the cell voltage and record both the concentration and the voltage in your Data Table.

F. Using the Nernst equation, calculate the expected cell potential for your cell. Make sure to take into account the appropriate number of electrons in your calculation. Show your calculation and record the values in the Data Table.

G. Compare your expected value to the measured value. Is your cell spontaneous?

H. Identify one way you could increase the cell potential of this cell.

V. Submit your Assignment on Thursday 5/7 by 3:30 pm (Section 1003) or 10 pm (Section 2001).

Submit your Data Tables using the "Submit Assignment" button in Canvas for Lab 12.

DATA TABLE PAGE 1:**Electrochemical cells under standard conditions:**

Cell	Anode	Cathode	Predicted E°_{cell} (V)	Measured E°_{cell} (V)
Zn and Cu				
Cu and Pb				
Pb and Ag				
Pb and Mg				
Pb and Zn				
Summary of your results				

DATA TABLE PAGE 2:**Concentration cells:**

	Metal #1 first cell	Metal #1 second cell	Metal #2 first cell	Metal #2 second cell
Identity				
right cell concentration (M)	0.500 M	0.500 M	0.500 M	0.500 M
left cell concentration (M)				
Measured Voltage (V)				
Calculated Voltage (V)				
Sample calculation				
Summary of your results				

DATA TABLE PAGE 3:

	Anode	Cathode
Identity		
half-reaction		
Concentration (M)		
Measured voltage (V)		
Predicted voltage (V)		
Sample calculation		
Compare the results between the predicted and measured voltage		
How could you increase the potential of this cell?		