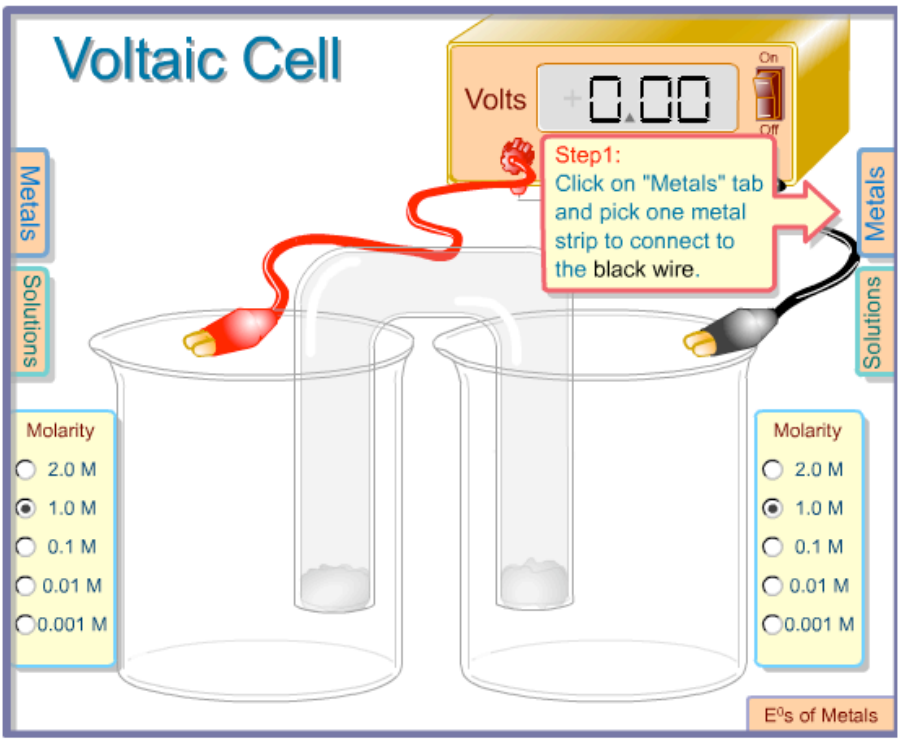
Concentration Cells

Name_____ Lab Section_____

Problem Statement: How does concentration affect the electrical properties of chemical reactions?

I. Data Collection:

A. Go to http://cheminfo.chem.ou.edu/~mra/home.html and open the Concentration Cells Simulation. Your screen should look like the figure.



This simulation contains an apparatus for measuring the voltage generated by chemical reactions. This apparatus is called a voltaic cell. Pop out menus will allow you to select metals (electrodes) and ionic solutions to be placed into two beakers that are connected by a salt bridge. In this experiment you will be specifying the concentration of the solutions being placed in the beakers in order to study how concentration affects chemical reactions. You will then connect the metals to a voltmeter to measure the cell voltage (E).

B. Click on the right pop-out tab for metals and select silver. Click on the right pop-out tab for solutions and select $AgNO_3$ (aq). Specify a concentration of 2.0 M. Use the left tabs and select Ag and $AgNO_3$ (aq) with a concentration of 2.0 M. Click on the power switch of the voltage meter. Record the cell voltage in the following table.

Trial	[$AgNO_3$] right half-cell	[$AgNO_3$] left half-cell	Voltage (E)
1	2.0 M	2.0 M	
2	2.0 M	1.0 M	
3	2.0 M	0.1 M	
4	2.0 M	0.01M	
5	2.0 M	0.001 M	

C. Repeat the reaction with the concentrations specified for trial 2 in the previous table and record the voltage. When the reaction has stopped, a molecular view comes available. Click on the molecular view for the left beaker and describe what is happening. Write a chemical equation for this half-reaction.

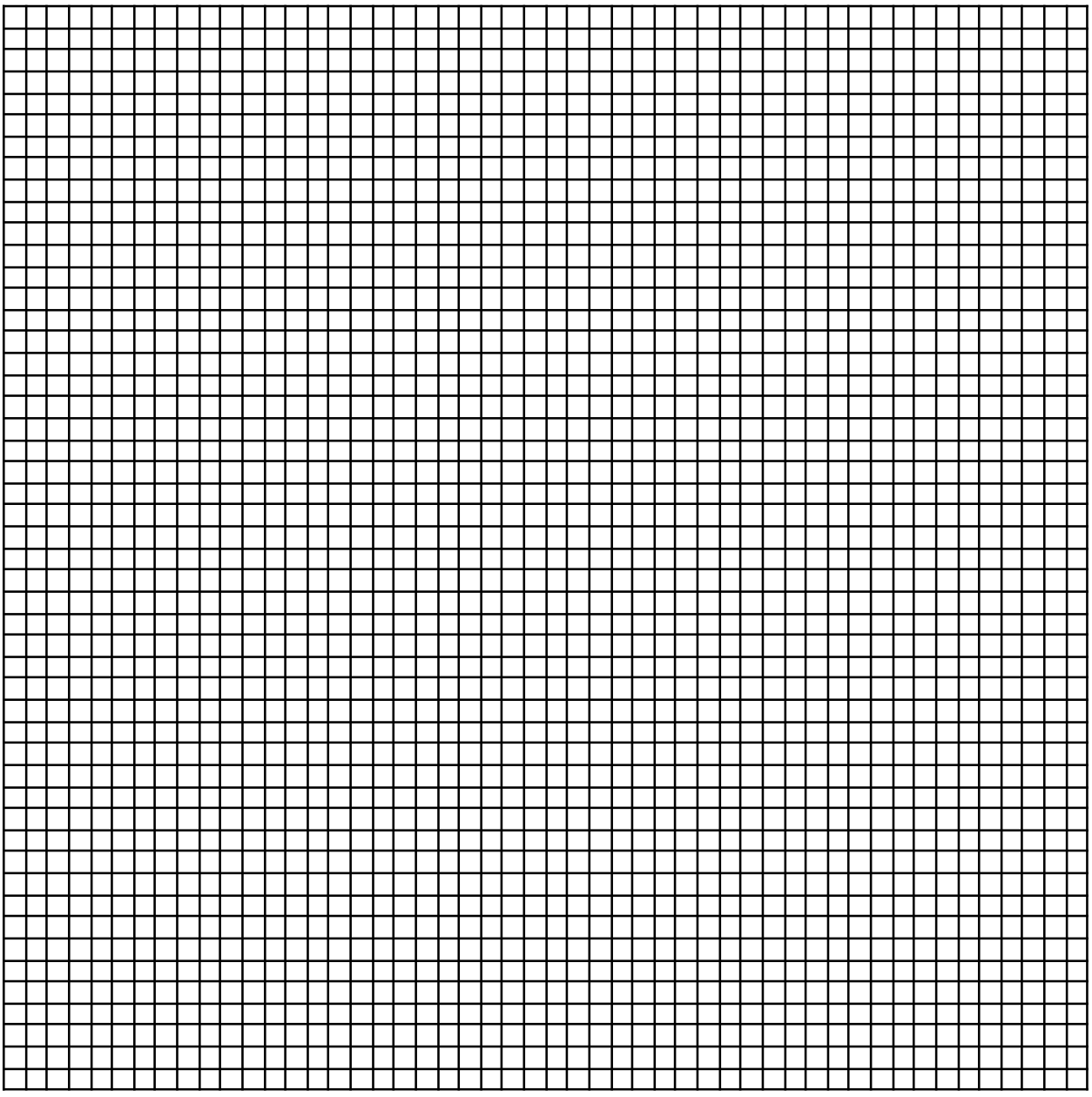
Click on the molecular view for the right beaker and describe what is happening. Write a chemical equation for this half-reaction.

D. Repeat the reaction with the concentrations specified for the remaining trials in the previous table and record the voltages.

II. Data Analysis and Interpretation

A. Write a balanced net ionic chemical equation for the overall reaction of this voltaic cell. Specify the concentrations of the Ag^+ in the reaction. How many electrons are transferred in the reaction per Ag^+?

B. On the following graph, or using a graphing program, plot the relationship between the change in concentration vs. voltage. What happens to the voltage as the concentration changes? What is the nature of this relationship? Are the changes directly proportional? (Optional. How are they related mathematically? Using a graphing program plot the amount of rate vs. the temperature. Then use the curve fitting function of your graphing program to draw the best line through all of the points. Try each of the available functions and see which gives you the best fit. Record the equation of your best-fit line.)



C. (Optional) Use the Nerst equation to calculate the expected value for the voltage of one of the trials in section I. Compare this with the value you obtained experimentally.

$$E = E^{o} - .059/n \log Q$$

III. Data Collection:

Repeat the procedure of section I. for the copper concentration cell. Record your data in the following table.

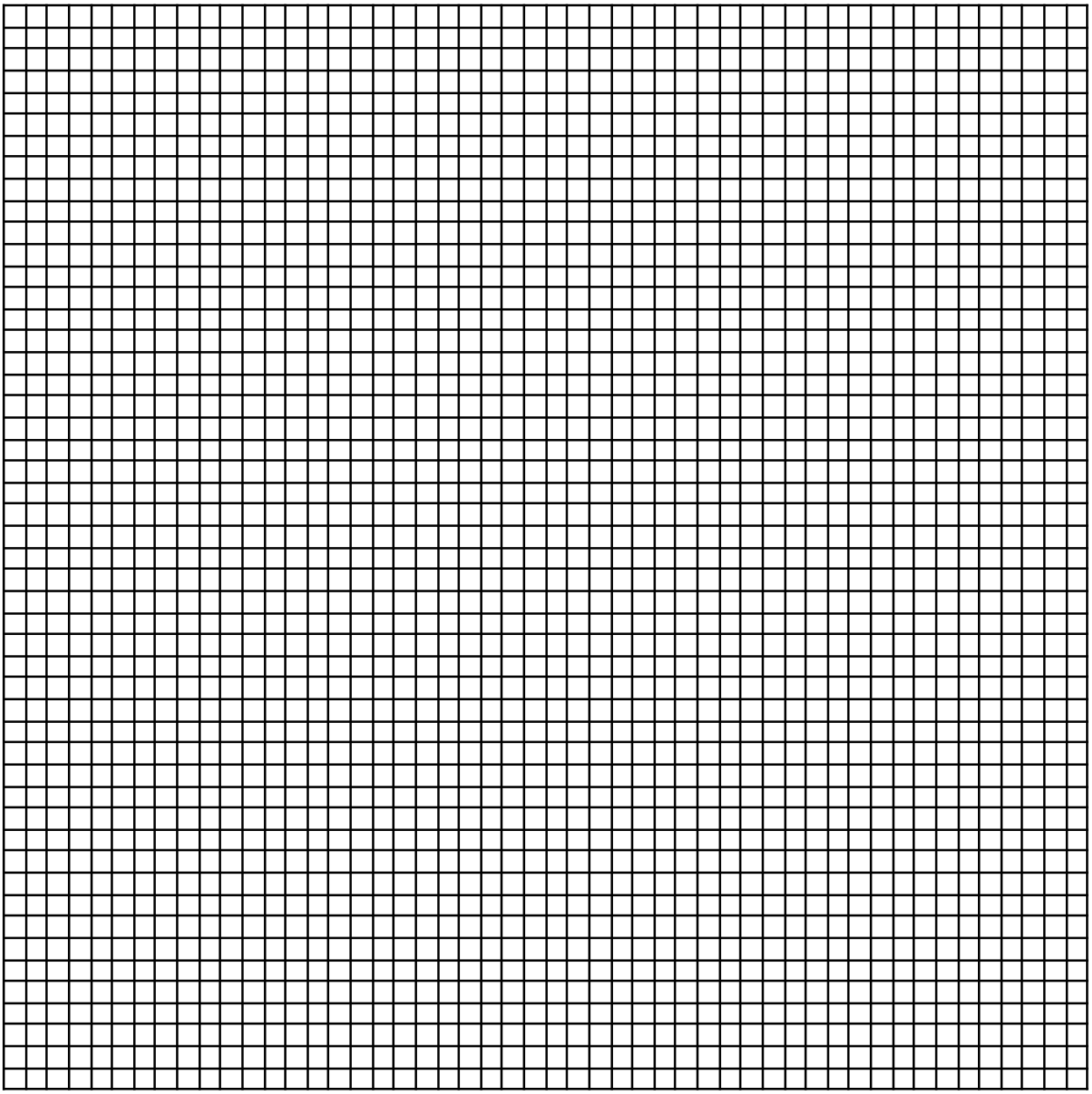
Trial	$[Cu(NO_3)_2]$ right half-cell	$[Cu(NO_3)_2]$ left half-cell	Voltage (E)
1	2.0 M	2.0 M	
2	2.0 M	1.0 M	
3	2.0 M	0.1 M	
4	2.0 M	0.01M	
5	2.0 M	0.001 M	

IV. Data Analysis and Interpretation

A. Write a balanced net ionic chemical equation for the overall reaction of this voltaic cell. Specify the concentrations of the Cu^{2+} in the reaction. How many electrons are transferred in the reaction per Cu^{2+}?

B. Compare the values you obtained for voltages for Cu^{2+} solutions with those you obtained for the Ag^{+} solutions. Explain any differences you observe.

B. On the following graph, or using a graphing program, plot the relationship between the change in concentration vs. voltage. What happens to the voltage as the concentration changes? What is the nature of this relationship? Are the changes directly proportional? (Optional. How are they related mathematically? Using a graphing program plot the amount of rate vs. the temperature. Then use the curve fitting function of your graphing program to draw the best line through all of the points. Try each of the available functions and see which gives you the best fit. Record the equation of your best-fit line.)



C. (Optional) Use the Nerst equation to calculate the expected value for the voltage of one of the trials in section I. Compare this with the value you obtained experimentally.

$$E = E^{o} - .059/n \log Q$$