Name _____ Lab Section: _____

Electrochemical Cells Part II

Problem Statement: What affects the amount of metal plating out on the cathode in an electrolytic cell?

Checkout a computer from the Technology TA. For this investigation you will use a simulation located at http://media.pearsoncmg.com/bc/bc_0media_chem/chem_sim/electrolysis_fc1_gm_11-26-12/main.html. You may also go to the Syllabus link on the CHEM 1515 web site to more easily access this site. At this link you will see three tabs titled: Overview; Learner Outcomes and Experiment. Review the Overview and the Learner Outcomes, then click on the Experiment tab and click on the Run Demonstration button. In the Demonstration mode you will learn what features of the simulation can be changed and how to change those features. After running the Demonstration you will go to the Experiment Mode where you will setup each experiment so that you can collect evidence that will allow you to answer the Problem Statement.

Based on the Demonstration answer the following questions.

1a. At which metal strip does oxidation occur (left-hand electrode or right-hand electrode)? Write the half reaction that occurred at this metal strip (anode).

half-reaction:

b) At which metal strip does reduction occur (left-hand electrode or right-hand electrode)? Write the half-reaction that occurred at this metal strip (cathode).

half-reaction:

c) Briefly describe how the mass of the anode and cathode changed during the experiment.

d) How many electrons are transferred in the reaction per $Cu^{2+}_{(aq)}$ ion? How many moles electrons are transferred in the reaction per mol of $Cu^{2+}_{(aq)}$ ion?

e) Based on your observations is the relationship between the amount of time the experiment proceeds and the amount of metal that is plated out at the cathode directly proportional, inversely proportional, or not related? Briefly, what evidence do you have to support your choice.

2a. Define the term *electric current*.

b) What particle(s) are pushed out of the power supply and through the wire connected to the right-hand electrode and are pulled by the power supply through the wire connected to the left-hand electrode?

c) From careful observation of the Microscopic View describe how these particles (part 2b) move/flow through the electrochemical circuit.

Before continuing you will have a class discussion of your answers to Questions 1 and 2.

Figure I shows the initial view of the experimental apparatus.

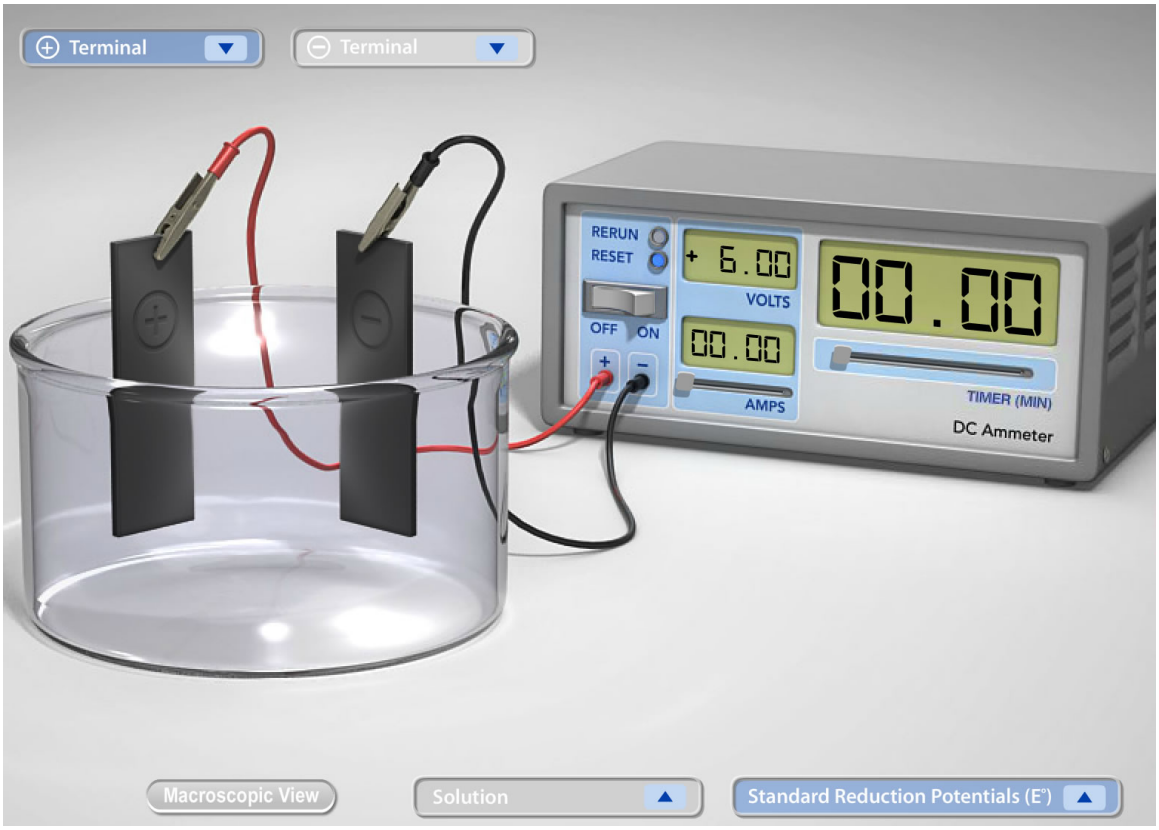

Figure I. Equipment setup showing; the Power Supply where the voltage (held constant in this simulation), current and time are controlled; two metal strips (electrodes) that are connected to the Power Supply with electrical wires coated with a plastic material; and a glass container that will hold the aqueous solution of a metal ion. Dropdown menus allow the choice: of the metal for each metal strip, the aqueous solution in the glass container, a view of the particulate level at important locations in the electrolytic cell, and a list of reduction half-reactions.

Find three other students and form a group of four. Each member of the group should have a computer and be connected to the simulation web site.

Data Collection:

A. Perform 4 to 6 experiments using silver as the metal for both the left-hand metal strip and the right-hand metal strip, in a solution of silver (I) nitrate to determine what affects the amount of silver plated out on the cathode and lost from the anode. Discuss, as a group, what data you are going to collect and agree on a data table to organize the data. Record the data in your data table, and when your data is collected write your data on one of the boards in the laboratory. Within the group of four students split into two groups and each pair of students complete all experiments that have been decided and then compare your data before reporting to the class and recording in your notebook.

A1. Data Table for Experiments 1 – 5 with Silver.

Write the reduction half-reaction that occurs at the cathode: _____

B. Perform two more sets of 4 to 6 experiments using at least two additional metals as the anode and as the cathode in a solution of that metal ion to determine what affects the amount of the metal plated out on the cathode and lost from the anode. Decide what data you are going to collect and agree on a data table to organize the data. Within the group of four students split into two groups and each pair of students complete all experiments that have been decided and then compare your data before reporting to the class and recording in your notebook. When your data is collected write your data on one of the boards in the laboratory.

Briefly describe each of these experimental setups in sufficient detail that another student would be able to use the description to setup the identical experiment and collect the same data.

B1. Describe the experimental setup for Experiments 6 - 10:

B2. Data Table for Experiments 6 – 10 with metal _____.

Write the reduction half-reaction that occurs at the cathode: _____

C1. Describe the experimental setup for Experiments 11 - 15:

C2. Data Table for Experiments 11 – 15 with metal _____.

Write the reduction half-reaction that occurs at the cathode: _____

II. Data Analysis and Interpretation

A. Based on Experiments 1 – 5 (the first set of experiments with silver) what relationship(s) did you discover. What evidence do you have to support the relationship(s). You should write a mathematical proportionality to summarize the relationship(s).

B. Based on Experiments 6 – 10 (the second set of experiments with metal ____) what relationship(s) did you discover. What evidence do you have to support the relationship(s). You should write a mathematical proportionality to summarize the relationship(s).

C. Based on Experiments 11 – 15 (the third set of experiments with metal ____) what relationship(s) did you discover. What evidence do you have to

support the relationship(s). You should write a mathematical proportionality to summarize the relationship(s).

D. When comparing the results of Experiments 1 – 5 with the experimental results of Experiments 6 – 10 and 11 – 15 does/do an/any additional relationship(s) appear? If so what is/are the relationship(s) and what evidence do you have to support the relationship(s)?

E. Combine all of the factors you identified in A – D into a single proportionality expression. Calculate a proportionality constant (called the Faraday) for the expression. What are the units for this constant?