Name _____ Lab Partner _____

TA Name _____ Section _____ Date _____

Electrochemical Cells PreLab Worksheet

1. There are several hazards associated with the chemicals in the electrochemical cells experiment. For each chemical, determine which hazards it possesses. (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

(a) 3.0 M HCl

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

(b) 3.0 M NaOH

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

(c) 0.1 M $Cu(NO_3)_2$

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

(d) 0.1 M $AgNO_3$

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

(e) graphite rods

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

(f) ascorbic acid (solid)

- causes dark spots if spilled on skin
- corrosive
- flammable
- irritating vapors
- toxic if ingested
- none listed

2. Select the statements that are correct with respect to waste disposal in the Electrochemical Cells Experiment. (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The electrodes should be discarded in the proper jar.
- Rinsings from the half-cell module can be flushed down the sink.
- Dilute copper and ascorbic acid solutions should be disposed of in the waste container in the hood.
- The contents of the half-cell module should be disposed of in the waste container in the hood.
- Metal and graphite electrodes should be rinsed with water, dried, and returned to their positions on the lab bench.
- No waste will be generated during this experiment.

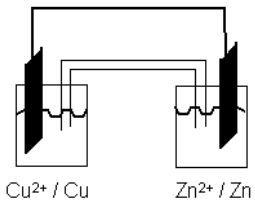
3. In Part C of the experiment, you will need to prepare 60. mL of a solution that is 0.10 M in sodium hydrogen phosphate heptahydrate ($Na_2HPO_4 \cdot 7\ H_2O$, MW = 268.1 g/mol) and 0.10 M in ascorbic acid ($C_6H_8O_6$, MW = 176.1 g/mol).

(a) How many grams of sodium hydrogen phosphate heptahydrate will you need? Report your answer to three significant figures.

(b) How many grams of ascorbic acid will you need? Report your answer to three significant figures.

To save time in lab, record these values in your lab notebook for use in Part C of the experiment.

4. Consider the case where the Cu^{2+}/Cu and Zn^{2+}/Zn half cells are connected in an electrochemical cell, as shown below. In the picture, the two black rectangles are the metal electrodes, connected by an external wire. The electrodes are immersed in solutions of their respective ions.



Use the table of Standard Reduction Potentials in the Lab Manual to answer the following questions.

(a) Which direction do the electrons go in the external wire?

(b) In which half cell will a reduction take place?

(c) Which half cell is the anode?

(d) Which direction do the anions in the salt bridge flow?

(e) Select the true statement about phenomena at the electrodes. (*Note: The order of these options may be different in the WebAssign question.*)

- The copper electrode increases in mass, and the zinc electrode decreases in mass.
- The zinc electrode increases in mass, and the copper electrode decreases in mass.

(f) What happens if the leads to the copper and zinc electrodes are switched?

(g) What is the standard cell potential (E°_{cell})?

5. Consider the following two chemical reactions, which are the reverse of each other.

$Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb$

$Zn^{2+} + Pb \rightarrow Zn + Pb^{2+}$

Note that both reactions are written in one direction, rather than as equilibria. Either might occur in the electrochemical cells you will use in the lab.

(a) Predict which of these two reactions will be spontaneous. Use the table of Standard Reduction Potentials in the Lab Manual.

(b) What is the standard cell potential (E°_{cell})?

6. Standard cell potentials are determined with 1.0 M solutions of ions. In this experiment, we will use 0.10 M solutions of Zn^{2+}, Cu^{2+}, Pb^{2+}, and Ag^{+} to minimize the amount of hazardous waste generated. In this series of questions, you will figure out what effect this will have on the voltages you observe.

Consider a cell consisting of a Cu^{2+}/Cu couple and a Ni^{2+}/Ni couple.

(a) Starting with 1.0 M solutions of ions (standard conditions), evaluate Q in the Nernst Equation.

(b) What is log Q for this cell?

(c) The cell potential in this case should be which of the following? (*Note: The order of these options may be different in the WebAssign question.*)

- greater than E°
- less than E°
- equal to E°

(d) Starting with 0.1 M solutions of ions (at room conditions), evaluate Q in the Nernst Equation.

(e) What is log Q for this cell?

(f) The cell potential in this case should be which of the following? (*Note: The order of these options may be different in the WebAssign question.*)

- greater than E°
- less than E°
- equal to E°

7. Standard cell potentials are determined with 1.0 M solutions of ions. In this experiment, we will use 0.10 M solutions of Zn^{2+}, Cu^{2+}, Pb^{2+}, and Ag^{1+} to minimize the amount of hazardous waste generated. In this series of questions, you will figure out what effect this will have on the voltages you observe.

Consider a cell consisting of a Cu^{2+}/Cu couple and an Ag^{1+}/Ag couple.

(a) Starting with 1.0 M solutions of ions (standard conditions), evaluate Q in the Nernst Equation.

(b) What is log Q for this cell?

(c) The cell potential in this case should be which of the following? (*Note: The order of these options may be different in the WebAssign question.*)

- greater than E°
- less than E°
- equal to E°

(d) Starting with 0.1 M solutions of ions (at room conditions), evaluate Q in the Nernst Equation.

(e) What is log Q for this cell?

(f) The cell potential in this case should be which of the following? (*Note: The order of these options may be different in the WebAssign question.*)

- greater than E°
- less than E°
- equal to E°