REPORT SHEET

Name: Alexy eoh Role in Experiment: _____

Name: _____ Role in Experiment: _____

TA: _____ Section: _____ Due Date: _____ Date Submitted: _____

Report Sheets are to be turned in by the indicated due date. Turn in **one** set of Report Sheets per group. Students caught bringing pre-answered Report Sheets into lab will receive a zero for that lab that cannot be replaced.

A–C. Cu–Zn, Cu–Mg, and Zn–Mg Batteries: Comparison of Measured and Calculated Voltages Based on Half Reactions

1. Complete the following reactions below. If no reaction occurred, write *no reaction.*

   $Cu(s) + CuSO_4(aq) \rightarrow$ No reaction

   $Cu(s) + ZnSO_4(aq) \rightarrow$ No reaction

   $Zn(s) + ZnSO_4(aq) \rightarrow$ No reaction

   $Zn(s) + CuSO_4(aq) \rightarrow$ $Cu(s) + ZnSO_4(aq)$

2. Record the voltage for the **Cu–Zn** battery, and compare this with the calculated $E°$.

   Voltage (Experimental $E°$) = 1.100 Calculated $E°$ = 1.100

   Anode Half-Reaction: $Zn(s) \rightarrow Zn^{2+} + 2e^-$ $E°_{ox}$ = 0.763

   Cathode Half-Reaction: $Cu^{2+} + 2e^- \rightarrow Cu(s)$ $E°_{red}$ = 0.337

3. What happens when the salt bridge is removed?

   The reaction would proceed a bit then stop as the solutions become charged

4. If you need to double the voltage supplied by Cu–Zn battery, how would you connect two Zn–Cu cells, series or parallel?

   Series

   ~~Parallel~~

$Mg^{2+} + 2e^- \rightarrow Mg(s)$ -2.37 $Cu^{2+} + 2e^- \rightarrow Cu(s)$ 0.337

5. Complete the following reactions below. If no reaction occurred, write *no reaction.*

$Mg(s) + MgSO_4(aq) \rightarrow$ No reaction

$Mg(s) + CuSO_4(aq) \rightarrow$ $MgSO_4(aq) + Cu(s)$

$Cu(s) + MgSO_4(aq) \rightarrow$ No reaction

6. Complete the information below for the **Cu–Mg** voltaic cell.

Voltage = 2.707 Calculated $E°$ = 2.707

Anode Half-Reaction: $Mg(s) \rightarrow Mg^{2+} + 2e^-$ $E°_{ox}$ = 2.37

Cathode Half-Reaction: $Cu^{2+} + 2e^- \rightarrow Cu(s)$ $E°_{red}$ = 0.337

7. Complete the following reactions below. If no reaction occurred, write *no reaction.*

$Zn(s) + MgSO_4(aq) \rightarrow$ No reaction

$Mg(s) + ZnSO_4(aq) \rightarrow$ $MgSO_4(aq) + Zn(s)$

8. Complete the information below for the **Zn–Mg** voltaic cell.

Voltage = 1.607 Calculated $E°$ = 1.607

Anode Half-Reaction: $Mg(s) \rightarrow Mg^{2+} + 2e^-$ $E°_{ox}$ = 2.37

Cathode Half-Reaction: $Zn^{2+} + 2e^- \rightarrow Zn(s)$ $E°_{red}$ = -0.763

9. Examine the voltages of the three voltaic cells constructed above. Is there any relationship among the measured voltages for the Zn–Cu, Mg–Zn, and Mg–Cu cells? Explain.

the greater the difference in standard reduction potential, the greater the voltage

~~they are all named cathode-anode voltaic cell~~

D. Effects of Concentration: Cu–Zn Battery

1. Use the Cu–Zn battery. Record below the voltage generated under of each set of conditions.

TABLE 10.2 Variation of the Zn–Cu Cell Potential as Concentrations of $ZnSO_4$ and $CuSO_4$ Solutions Are Changed

		$ZnSO_4$		
		1.0 M	1.0×10^{-2} M	1.0×10^{-4} M
$CuSO_4$	1.0 M	1.100	1.155	1.211
	1.0×10^{-2} M	1.047	1.102	1.158
	1.0×10^{-4} M	0.991	1.046	1.102

2. Use the Nernst equation to calculate the cell potential expected for a Cu–Zn battery with **1.0 M $ZnSO_4$** and **1.0×10^{-4} M $CuSO_4$** solution concentrations. Show your calculations in detail. Compare the experimental potential with the calculated cell potential by summarizing the two values as outlined below.

Experimental *E:* 1.211

Calculated *E:*

$$1.100 - \frac{0.0592}{2} \log\left(\frac{1}{1.0 \times 10^{-4}}\right) = 0.9816$$

3. Discuss the agreement of the experimental and calculated cell potentials above. Suggest possible reasons for their difference.

They are very similar, ~~the difference~~ ~~the~~ one possible reason for their difference is the experiment taking place under ~~slightly~~ conditions slightly different from standard conditions.

4. What effect does decreasing the concentration of $ZnSO_4$ have on the cell if the $CuSO_4$ concentration is held constant? Explain this effect.

increases ~~lowers~~ voltage, this is because ~~zinc is the source of electrons~~ $\log(Q) = \log\left(\frac{[ZnSO_4]}{[CuSO_4]}\right)$ when $ZnSO_4$ decreases, the $\log\left(\frac{[ZnSO_4]}{[CuSO_4]}\right)$ decreases making the $\frac{0.0592}{n}\log(Q)$ smaller.

5. What effect does decreasing the concentration of $CuSO_4$ have on the cell if the $ZnSO_4$ concentration is held constant? Explain this effect.

lowers voltage b/c $E = E^0 - \frac{RT}{nF}\ln\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ becomes bigger when $[Cu^{2+}]$ becomes smaller

6. How does the voltage change with changes in the $[Zn^{2+}]/[Cu^{2+}]$ concentration ratio?

increases when $[Zn^{2+}]$ shrinks

shrinks when $[Cu^{2+}]$ shrinks

7. How does the strong or weak effect of concentration on the cell voltages effect the practical performance of common batteries?

Common batteries likely have a ~~relatively low concentration of the oxidized metal relative to the reduced metal~~ very specific relative concentration of the oxidized metal to the reduced metal to retain a specific voltage like 9volts for the 9volt battery

TA Signature
Ask your TA to review your work and sign your report. The TA will sign above once satisfied that the student has performed the entire procedure. The report will not be accepted or graded unless signed.