Filter Paper Electrochemical Cell

The study of oxidation-reduction reactions includes the understanding of reactions that a driven by electron flow. A change in oxidation number in both the reduced and oxidized species is an indicator of this type of reaction. This exercise explores the activity series, which describes reductive and oxidative potential of various metals and nonmetals.

This experiment is performed on filter paper and the metal and ionic solutions were chosen to reduce the amount and toxicity of the chemicals used to demonstrate the principle.

Metals will be ordered from most active to least active.
Electron transfer will be analyzed.

PROCEDURE

1. Cut six triangle shaped wedges out of a piece of filter paper and place the filter paper in a Petri dish. Place the Petri dish on paper toweling and label with the metals to be tested, as shown in Figure 1.

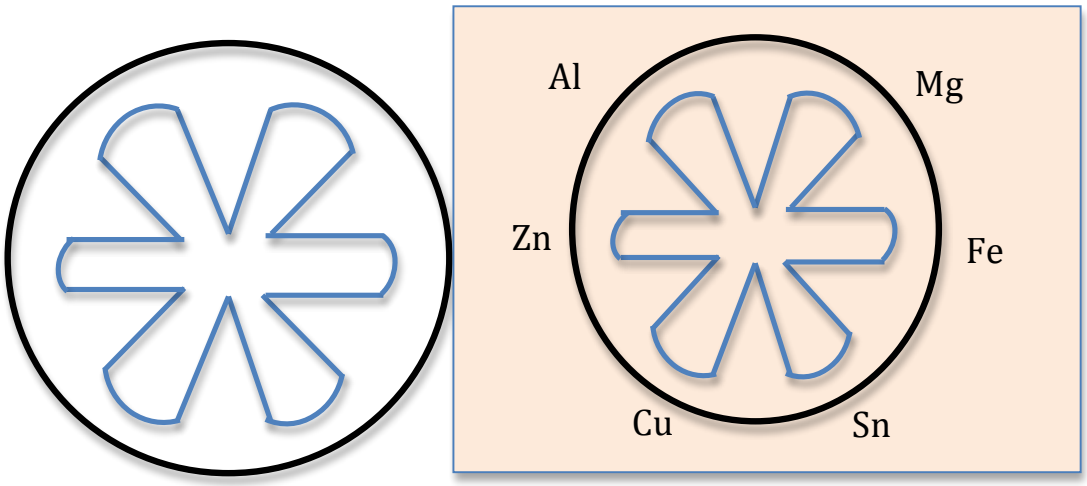

Figure 1.

2. Obtain a small plastic bag that contains pieces of the six metals to be used. Carefully sand each flat piece of metal on both to remove oxides. Then place them on the filter paper, as shown in Figure 2.

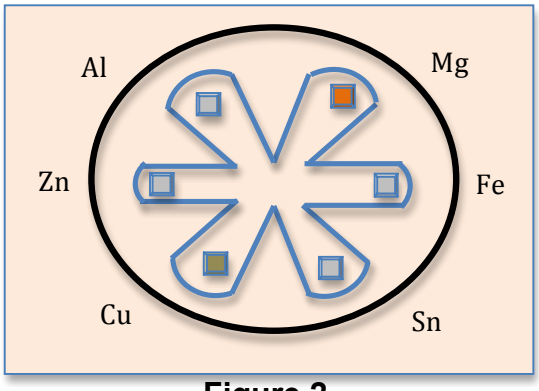

Figure 2.

3. There is a kit on your bench with 1 M solutions of the metal ions in dropper bottles. Place 1 drop of the corresponding solution on each metal.

4. Using a Pasteur pipet or capillary tube, add several small drops of 1 M KCl to saturate the filter paper. Be sure there is a continuous trail of KCl between each circle and the center. You may have to periodically reapply solution to the filter paper during the course of the experiment if it dries out. At this point your electrochemical cell is complete as shown in Figure 3.

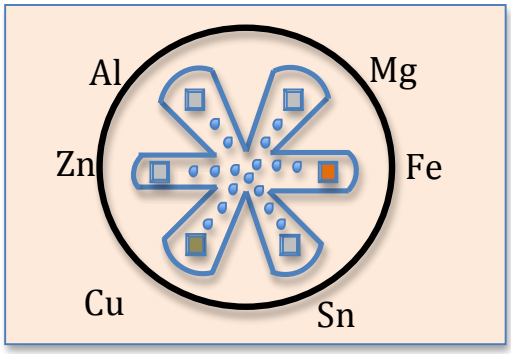

Figure 3.

5. Use the copper as the reference metal initially. This means that it will be positive pole. Place the negative pole on the Magnesium metal. After waiting for the reading to stabilize record the cell potential.

6. Repeat this strategy using copper as the reference and placing the negative pole on each metal respectively. (If any of the readings are negative switch your poles and be sure to note this in your data table.)

7. Complete the rest of the table by testing the cells which do not have copper in them. This should give a total of 15 electrochemical cells.

8. At this point you have collected enough information to rank the six metals. The voltage in these cells is generated by spontaneous reaction of the solutions involved therefore the metal that was most likely to be the negative pole is the

most likely to oxidize.

9. When you have finished, use forceps to remove each of the pieces of metal from the filter paper. Rinse each piece of metal with tap water. **Dry** it and return it to the correct container. Remove the filter paper from the Petri dish using forceps, and discard it as directed by your instructor. Rinse and dry the Petri dish with tap water.

Student Name:_____ Date: _____

Observations

Data Summary

Fill in the following table with the data gathered from the experiment.

Metal 1	Metal 2	Anode (-)	Cell Potential (V)
Copper	Iron		
Copper	Zinc		
Copper	Aluminum		
Copper	Tin		
Copper	Magnesium		
Iron	Zinc		
Iron	Aluminum		
Iron	Tin		
Iron	Magnesium		
Zinc	Aluminum		
Zinc	Tin		
Zinc	Magnesium		
Aluminum	Tin		
Aluminum	Magnesium		
Tin	Magnesium		

Order the metals in order from most active to least active based on the experiment that you ran and see if it matches the literature.

Activity Series	
Literature	Experimental
Magnesium	
Aluminum	
Zinc	
Iron	
Tin	
Copper	

Lab Questions

Did your activity series match the literature reference, if not was there an experimental explanation for this?

Which of the metals oxidizes most easily?

Draw the voltaic cell for the reaction of Aluminum and Zinc and label all of the parts as you learn them in class.

Green Question(s)

Comparing the cell that you drew with the experiment that you actually ran describe the reduction in chemical usage and increase in safety associated with this experiment.

References

Flinn ChemTopic™ Labs Publication No. 11096 Measuring Cell Potentials; Flinn Scienfic: 2014, pp. 1-4

Lab 10: RedOx Reactions. https://www.msu.edu/course/lbs/172l/Lab10-S06-Electrochemistry.pdf accessed on May 2, 2014

M. Picciotti, L. Tucker. Electrochemistry. Written in fall 2004.