

Electrochemical Cells Lab: Chemistry 30

Name _____ Date _____ Score _____

Purpose:

- To predict the voltage and direction of flow of electrons in various spontaneous electrochemical cells.
- To construct and measure the voltage as a function of time.
- To establish factors that may affect the output of voltage by a Voltaic cell over time.

Prelab:

- Label a diagram of predictions for each of the following cells
- Diagrams must clearly identify anode, cathode, movement of electrons, ions, voltage and give half reactions at each electrode.

1. $\text{Zn}_{(s)} / \text{Zn}^{2+}_{(aq)} // \text{Cr}_2\text{O}_7^{2-}_{(aq)} \text{H}^{+}_{(aq)} / \text{C}_{(s)}$
2. $\text{Ni}_{(s)} / \text{Ni}^{2+}_{(aq)} // \text{Cr}_2\text{O}_7^{2-}_{(aq)} \text{H}^{+}_{(aq)} / \text{C}_{(s)}$
3. $\text{Cu}_{(s)} / \text{Cu}^{2+}_{(aq)} // \text{Cr}_2\text{O}_7^{2-}_{(aq)} \text{H}^{+}_{(aq)} / \text{C}_{(s)}$
4. $\text{Zn}_{(s)} / \text{Zn}^{2+}_{(aq)} // \text{Cu}^{2+}_{(aq)} / \text{Cu}_{(s)}$
5. $\text{Zn}_{(s)} / \text{Zn}^{2+}_{(aq)} // \text{Ni}^{2+}_{(aq)} / \text{Ni}_{(s)}$
6. $\text{Ni}_{(s)} / \text{Ni}^{2+}_{(aq)} // \text{Cu}^{2+}_{(aq)} / \text{Cu}_{(s)}$

Note: Due to limited equipment, your lab group will only set up **one** of the cells above.

Your assigned cell is cell number _____.

The other lab groups will collaborate and share all the information gathered for their cell.

Apparatus:

- Voltmeter
- Porous cup
- Beakers
- Metals strips (be sure they are clean – use steel wool)
- Graduated cylinder

Procedure:

1. Label all your beakers / porous cups. The label must include the cell number as well as the chemical names.
 - a. Be sure that for each pair, that one solution is in a beaker and the other in a porous cup.
 - b. Always put the dichromate solutions into the glass beaker so that we can eliminate some of the discoloration that will result if you put this solution into the porous cups.
2. Use about 100 mL for all the metallic solutions. For the **dichromate solution**, use 75 mL dichromate and 25 mL of sulfuric acid.
 - a. Be sure the electrodes are VERY clean before you use them.
 - b. Weigh and record the mass of both electrodes in each cell.
4. Connect the cell so that the positive (red terminal) of the voltmeter is connected to the cathode and the negative (black terminal) of the voltmeter is connected to the anode.
5. Record the initial voltage that is produced by the cell.

6. Record the initial colors of the solution at the cathode and the solution at the anode.
7. Each day for a _____ days, record the voltage, any change of color at the anode and cathode.
Remember that a change may be the APPEARANCE of a color or the DISAPPEARANCE of a color.
8. At the end of the last day, take your cells apart carefully.
 - a. Carefully dry the electrodes and weigh again.
 - b. Record the new mass of each electrode

Observations:

1. Include mass of electrodes only on day the first and the last day
2. Every day record the voltage and solution colour.

Day 1

Cell	Initial voltage	Mass of anode	Colour of solution at anode	Mass of cathode	Colour of solution at cathode
1					
2					
3					
4					
5					
6					

Day 2

Cell	Voltage	Anode solution colour	Cathode solution colour
1			
2			
3			
4			
5			
6			

Day 3

Cell	Voltage	Anode solution colour	Cathode solution colour
1			
2			
3			
4			
5			
6			

Day 4

Cell	Voltage	Anode solution colour	Cathode solution colour
1			
2			
3			
4			
5			
6			

Day 5

Cell	Voltage	Anode solution colour	Cathode solution colour
1			
2			
3			
4			
5			
6			

Final Day

Cell	Voltage	Final Mass of anode	Colour of solution at anode	Final Mass of cathode	Colour of solution at cathode
1					
2					
3					
4					
5					
6					

Analysis:

1. Fill in the chart below using your observations from above:

Cell	Initial Mass (g)	Final Mass (g)	Change of Mass (g)
1. Anode			
1. Cathode			
2. Anode			
2. Cathode			
3. Anode			
3. Cathode			
4. Anode			
4. Cathode			
5. Anode			
5. Cathode			
6. Anode			
6. Cathode			

For each individual cell, compare the loss by one electrode to the gain by the other. Do your results support the concept of **conservation of mass**? Regardless of whether you answer YES or NO, provide scientific reasoning to support why this happened.

2. Use your observations to fill in the chart below:

Cell	Theoretical	Day 1 Volts	Day 2 Volts	Day 3 Volts	Day 4 Volts	Day 5 Volts
1						
2						
3						
4						
5						
6						

- On day one, the measured voltage should have been close to the theoretical value. Give reasons why this did or did not happen
- As the days went on, voltage may have changed. Give reasons why the changes have occurred.

Generalizations that can be drawn based on your observations: