Electro Lab Worksheet

Redox reactions, batteries, and electrolysis · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will use Electro Lab to watch a redox reaction, assign oxidation numbers, balance redox equations, build batteries from different metals, and calculate how much copper electroplating deposits.

Link: www.logicalhomeschooling.com/electro-lab.html

Objectives

- Identify oxidation, reduction, and the oxidizing and reducing agents; assign oxidation numbers.
- Balance redox equations with half-reactions.
- Explain how a galvanic cell works and calculate E°cell.
- Explain electrolysis and calculate the mass plated from current and time.

Materials: a computer or tablet with Electro Lab open, a calculator, a pencil, this worksheet. Time: about 60 minutes.

Key ideas. OIL RIG: Oxidation Is Loss, Reduction Is Gain (of electrons). An Ox, Red Cat: oxidation at the anode, reduction at the cathode. $E°cell = E°cathode - E°anode$. $Q = I \times t$; moles of e^- = $Q \div 96{,}485$ C/mol.

Part 1: Pre-lab

1. Name one battery-powered device you use and one thing that rusts. What do you think they have in common?

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Part 2: Stage 1, Redox

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

Observation or question	Answer
What formed on the zinc strip?	
What happened to the blue color? Why?	
Oxidation half-reaction	
Reduction half-reaction	
Substance oxidized / reducing agent	
Substance reduced / oxidizing agent	

Compound or ion	Element	Work	Oxidation number
Fe_2O_3	Fe		
H_2SO_4	S		
MnO_4^-	Mn		
$Cr_2O_7^{2-}$	Cr		

Part 3: Stage 2, Balancing

A. $Cu + Ag^+ \rightarrow Cu^{2+} + Ag$

Step	Your answer
Oxidation half-reaction	
Reduction half-reaction	
Balanced equation	
Check: total charge on each side	

B. Challenge (acidic): $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$

Step	Your answer
Balanced reduction half-reaction	
Balanced oxidation half-reaction (× ?)	
Balanced overall equation	

Part 4: Stage 3, Batteries

Sketch the zinc–copper cell. Label the anode, cathode, salt bridge, the direction of electron flow, and the voltmeter reading.

Left metal	Right metal	Anode	Cathode	Voltage (V)
Zn	Cu			

1. Calculate E°cell for an iron–copper cell. Show your work.

2. Which pair made the best battery? Explain using the table of reduction potentials.

3. What would happen if you removed the salt bridge? Why?

Part 5: Stage 4, Electroplating (challenge)

A 2.0 A current runs for 10 minutes. The key is the cathode: $Cu^{2+} + 2e^- \rightarrow Cu$ (63.55 g/mol).

Quantity	Work	Answer
Charge, Q = I × t		
Moles of electrons		
Moles of copper		
Mass of copper plated		

1. Compare a galvanic cell with an electrolytic cell. Which one needs a power source? Which is spontaneous?

Part 6: Practice problems

Answer these **without** Electro Lab. Standard reduction potentials: Ag^+/Ag +0.80 V · Cu^{2+}/Cu +0.34 V · Pb^{2+}/Pb –0.13 V · Fe^{2+}/Fe –0.44 V · Zn^{2+}/Zn –0.76 V · Al^{3+}/Al –1.66 V · Mg^{2+}/Mg –2.37 V

1. Find the oxidation number of N in NO_3^- and of C in CO_2.

2. In $2\ Al + 3\ Cu^{2+} \rightarrow 2\ Al^{3+} + 3\ Cu$, identify what is oxidized, what is reduced, and the oxidizing and reducing agents.

3. Use half-reactions to show why the equation in question 2 needs the coefficients 2 and 3.

4. Find E°cell for a zinc–silver cell. Which metal is the anode?

5. Silver plating: 1.5 A runs for 30 minutes. What mass of silver (107.87 g/mol, $Ag^+ + e^- \rightarrow Ag$) is deposited?

6. Why shouldn't you store copper(II) sulfate solution in an iron container?

Conclusion

Write 3 to 5 sentences explaining how a battery turns a chemical reaction into electricity, and how recharging reverses it. Use the words **oxidation**, **reduction**, **anode**, **cathode**, and **electrolysis**.