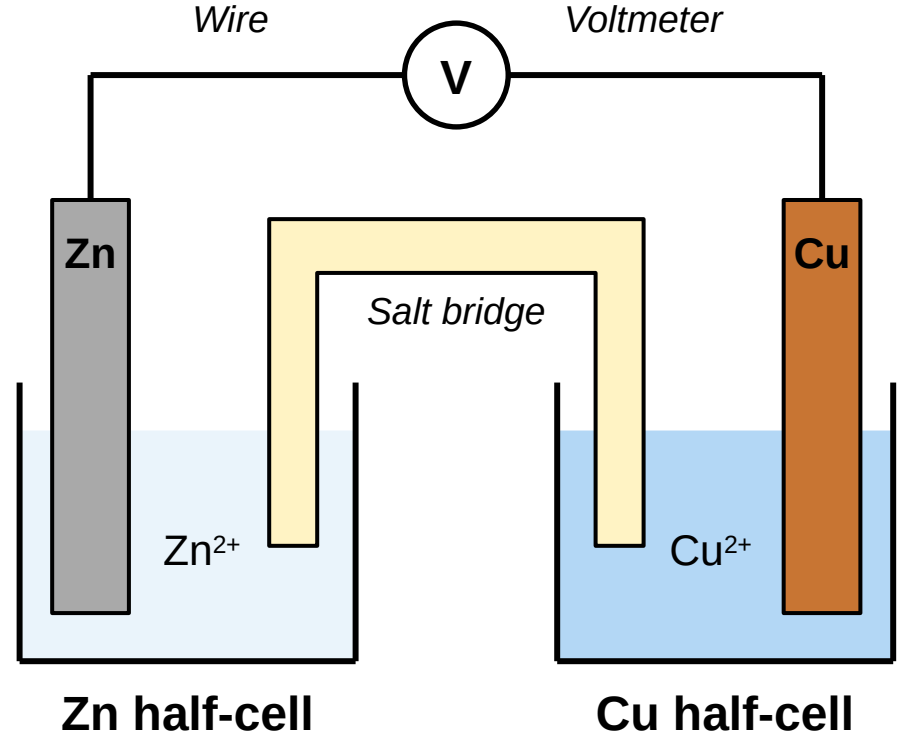


Essential Question

How can a redox reaction make electricity?

Parts of a Galvanic Cell

- Two half-cells: a metal in a solution of its ions
- Connected by a wire and a salt bridge



Galvanic (Voltaic) and Electrolytic Cells

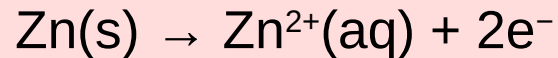
What Each Part Does

Part	Its job
Electrodes	Surfaces where oxidation and reduction happen
Half-cell solutions	Hold the ions that react or form
Wire	Carries electrons between the electrodes
Voltmeter	Measures the voltage of the cell
Salt bridge	Lets ions flow to keep each side neutral

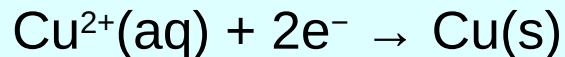
An Ox, Red Cat

- Oxidation (lose e^-) at the anode
- Reduction (gain e^-) at the cathode
- True for every electrochemical cell

An Ox: anode = oxidation

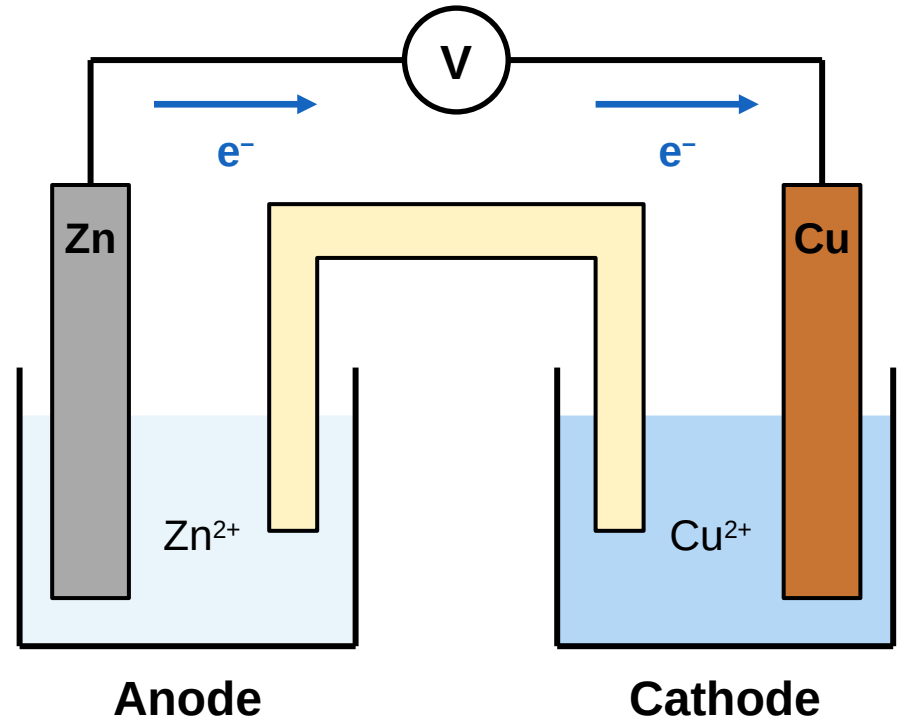


Red Cat: cathode = reduction



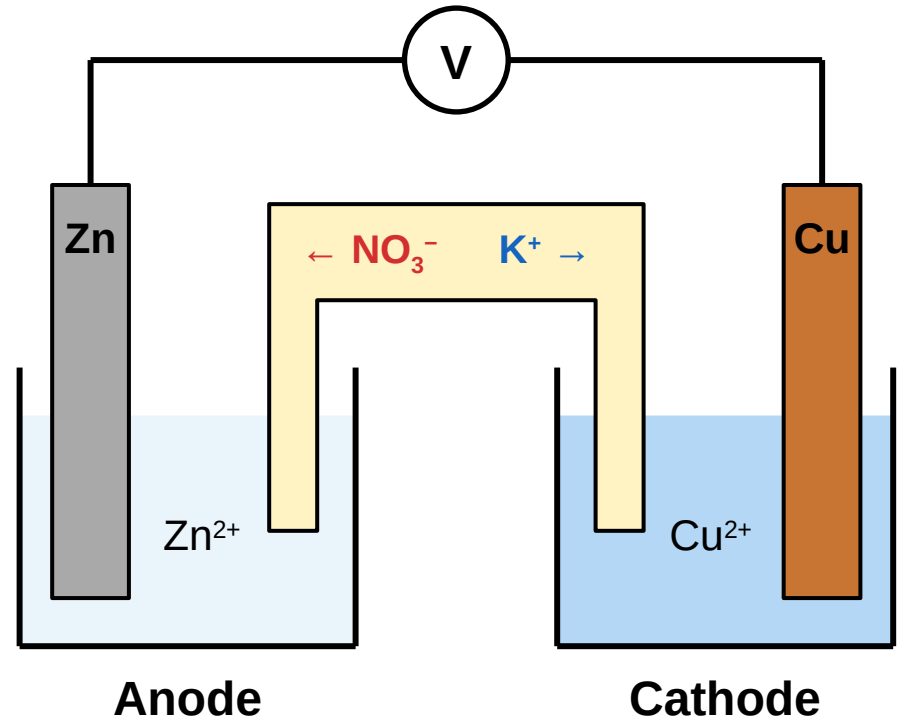
Electrons Flow Through the Wire

- Electrons move through the wire
- Always anode $\rightarrow$ cathode
- Electrons never travel through the solution



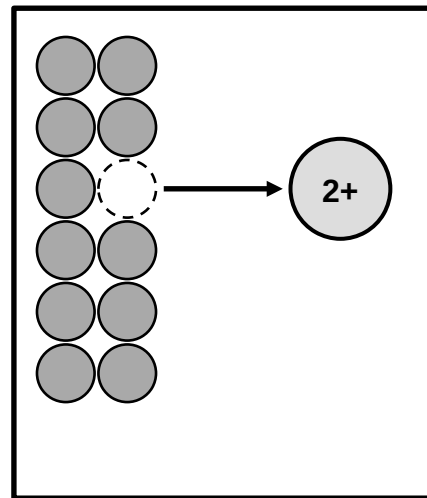
Ions Flow Through the Salt Bridge

- Anions move toward the anode
- Cations move toward the cathode
- Keeps each half-cell neutral

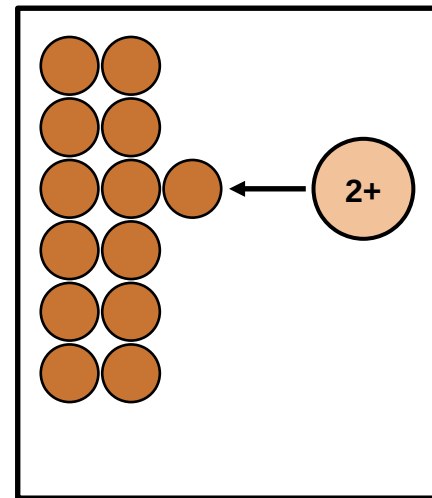


Mass and Concentration Changes

- Anode loses mass, cathode gains mass
- $[\text{Zn}^{2+}]$ increases, $[\text{Cu}^{2+}]$ decreases



Anode (Zn)

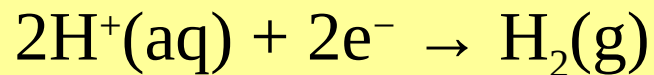
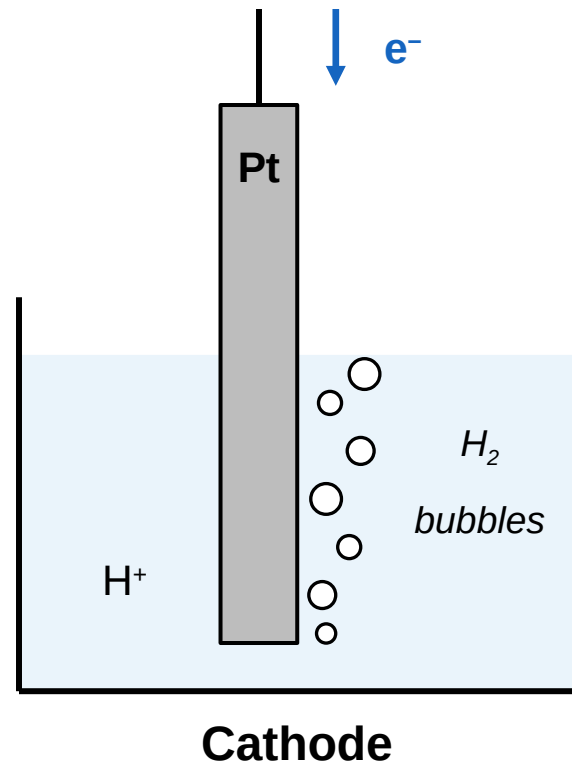


Cathode (Cu)



Gas at an Electrode

- Some half-reactions make a gas
- Gas bubbles form at that electrode
- Inert Pt electrode: carries e^- , does not react



Galvanic vs. Electrolytic

Galvanic (Voltaic)

Thermodynamically favored

Runs on its own

Makes electricity

Example: a battery in use

Electrolytic

Thermodynamically unfavored

Needs an external power source

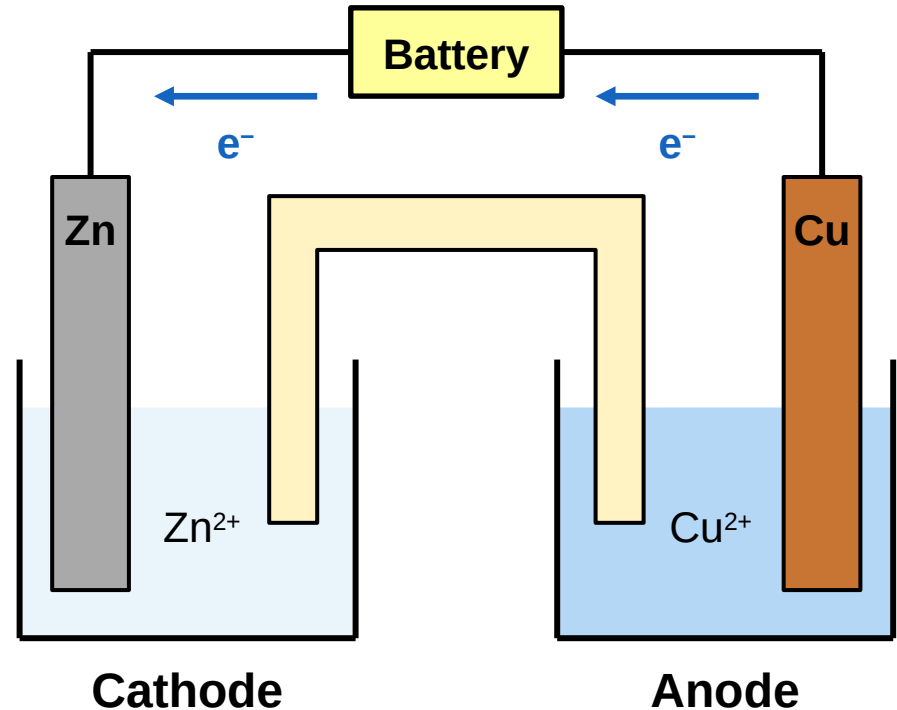
Uses electricity

Example: recharging a battery

Both: oxidation at the anode, reduction at the cathode

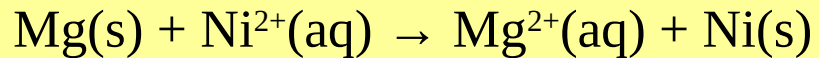
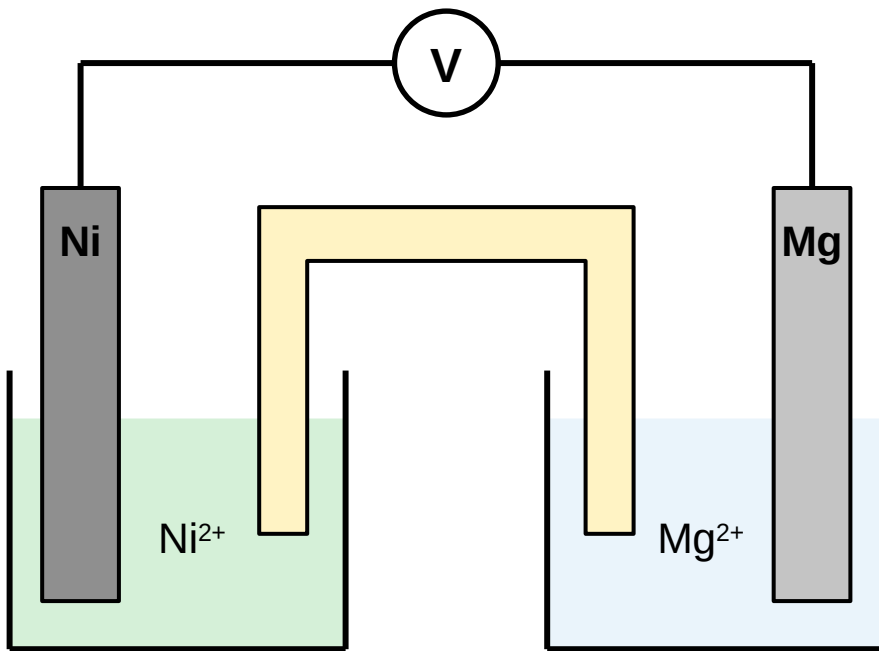
An Electrolytic Cell

- A battery forces the unfavored reaction
- Electrons are pushed the opposite way
- Zn^{2+} is reduced, Cu is oxidized



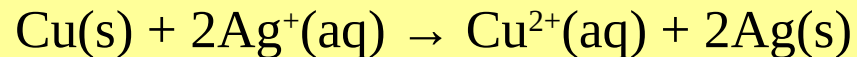
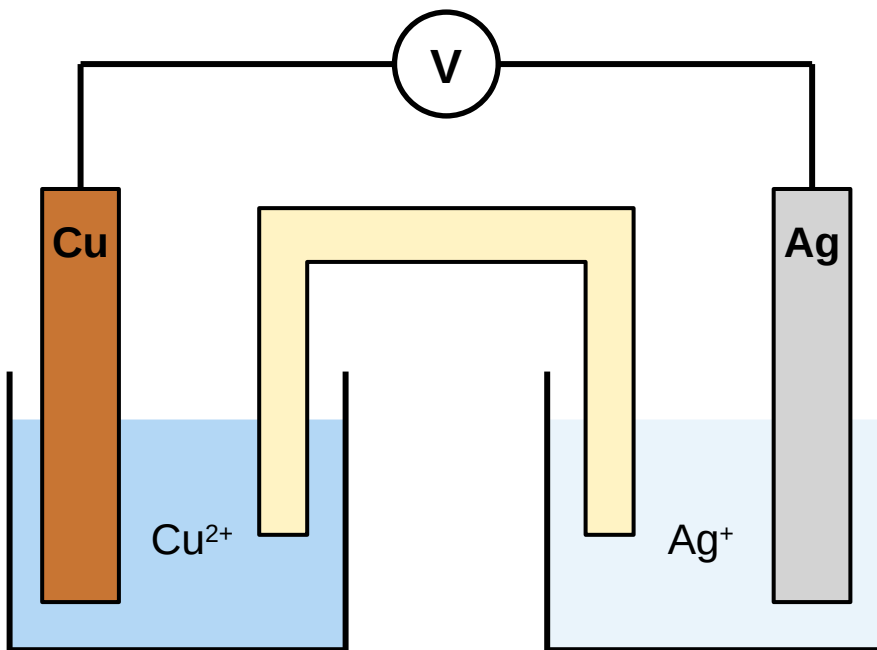
Example: Anode, Cathode, and e⁻ Flow

The cell below runs this favored reaction. Identify the anode and the cathode. Which way do electrons flow in the wire?



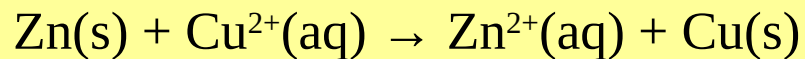
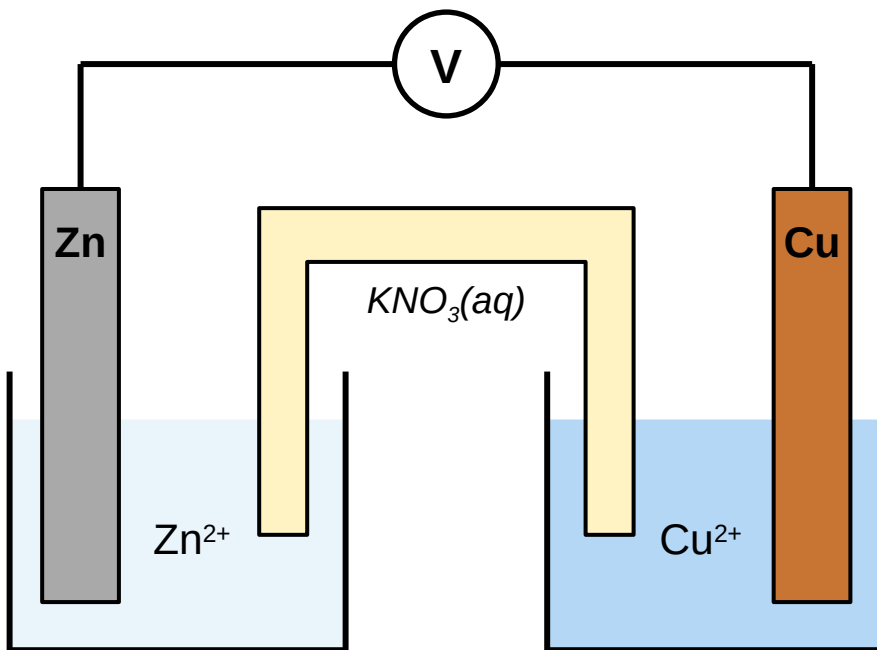
Example: Which Electrode Gains Mass?

Which electrode gains mass as this galvanic cell operates?
Justify your answer.



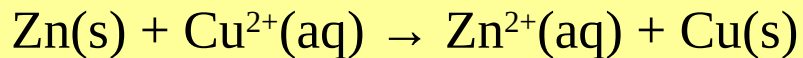
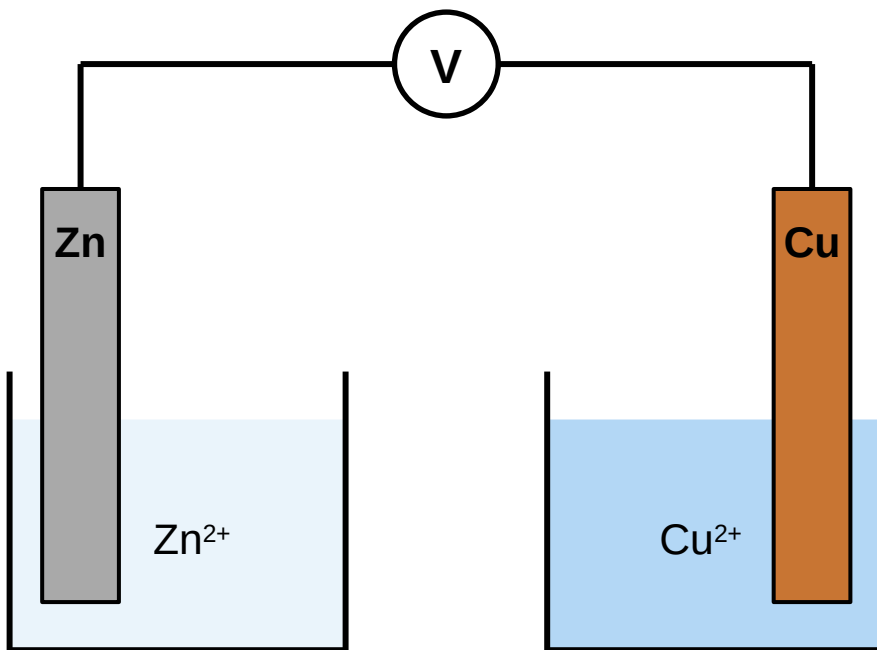
Example: Salt Bridge Ion Flow

The salt bridge contains $\text{KNO}_3(\text{aq})$. As the cell operates, which way do K^+ and NO_3^- move? Explain.



Example: Removing the Salt Bridge

A student removes the salt bridge from an operating Zn/Cu cell, as shown. What happens to the voltmeter reading? Explain.



Big Ideas

- Galvanic: favored, makes electricity
- Electrolytic: unfavored, needs a power source
- e^- flow anode $\rightarrow$ cathode in the wire
- Ions flow through the salt bridge

An Ox
anode = oxidation

Red Cat
cathode = reduction