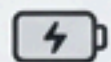
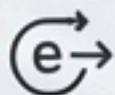


2.1 Electrochemical Cells

The Journey of the Electron:
Deconstructing the bridge between
chemical reactions and electrical energy.



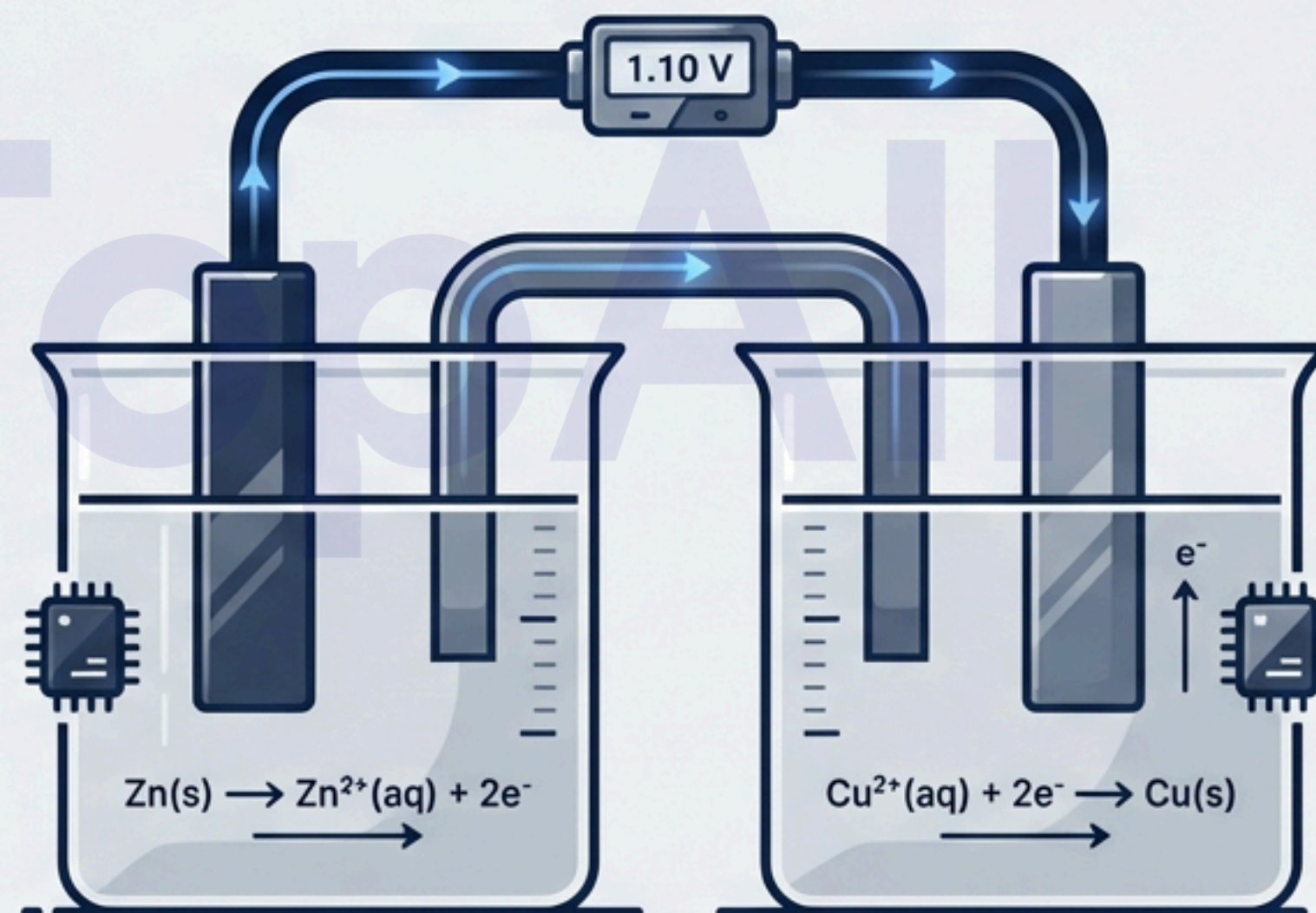
Chemical Energy
to Electrical Energy



Electron Flow:
Anode to Cathode



Salt Bridge
Completes Circuit



Bridging Chemistry and Electricity

[+] Spontaneous

Chemical Energy → Electrical Energy

Energy released during natural redox reactions is captured to produce electricity.

[-] Non-Spontaneous

Electrical Energy → Chemical Energy

External electrical energy is forced into a system to drive chemical transformations that would not otherwise occur.

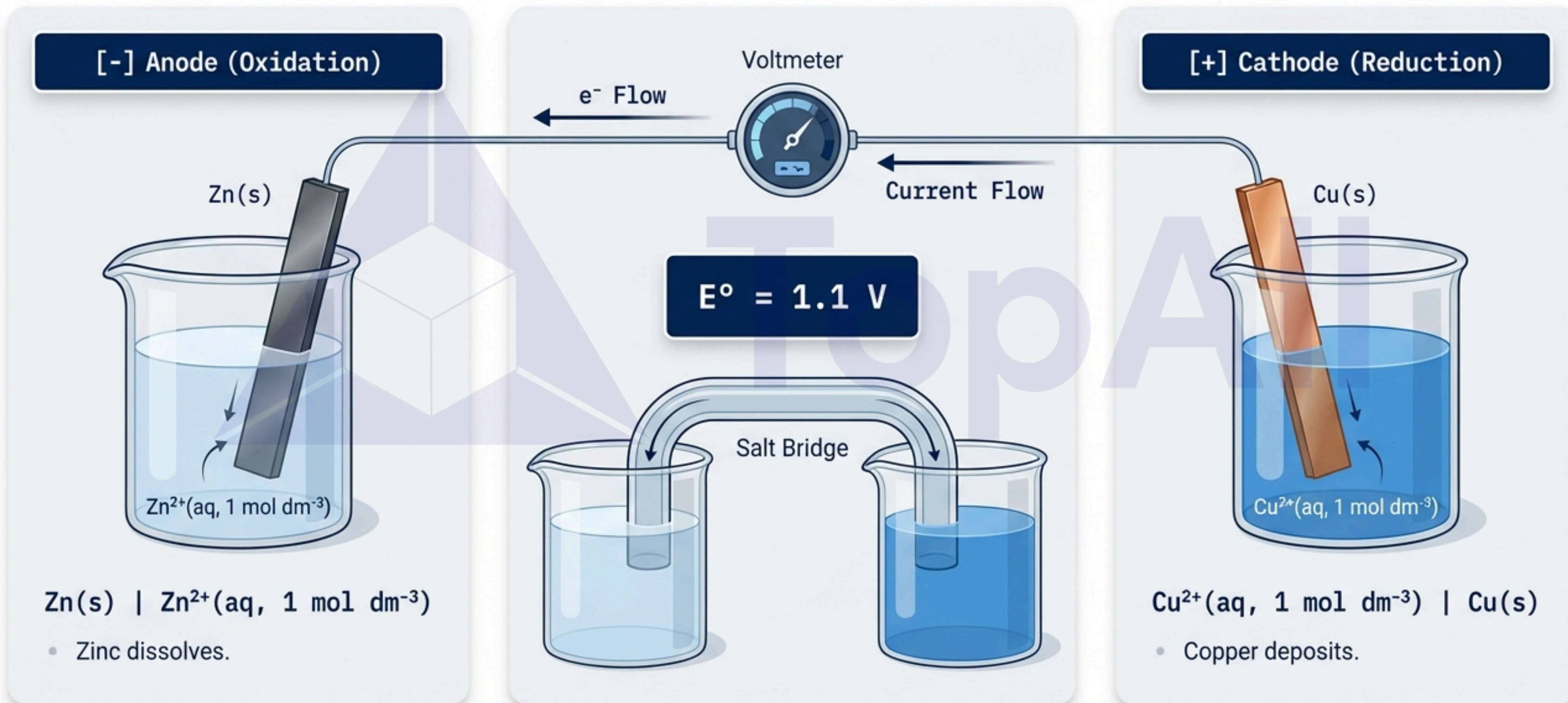
Real-World Applications

Batteries & Fuel Cells (Power generation)

Metallurgy (Sodium, Chlorine production)

Biology (Sensory signals to the brain)

Anatomy of the Daniell Cell





You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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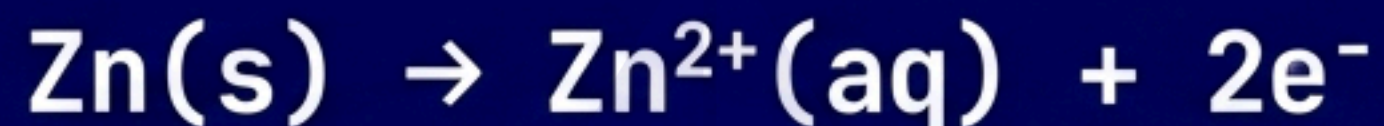
Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



The Invisible Electron Transfer

Oxidation Half-Reaction



Loses 2 electrons

Reduction Half-Reaction



Gains 2 electrons

Net Ionic Equation



This exact 2-electron transfer is the invisible engine generating the standard cell potential of 1.1 V.

Opposing Voltage & Cell Reversal

$$E_{\text{ext}} < 1.1 \text{ V}$$

Galvanic State

e^- flow: $\text{Zn} \rightarrow \text{Cu}$



Current: $\text{Cu} \rightarrow \text{Zn}$

- Zn dissolves
- Cu deposits
- Normal discharge

$$E_{\text{ext}} = 1.1 \text{ V}$$

Equilibrium

$$I = 0$$

- No flow of electrons
- No flow of current
- No chemical reaction
- Dead cell

$$E_{\text{ext}} > 1.1 \text{ V}$$

Electrolytic State

e^- flow: $\text{Cu} \rightarrow \text{Zn}$



Current: $\text{Zn} \rightarrow \text{Cu}$

- Zn deposits
- Cu dissolves
- Forced reversal

Galvanic vs. Electrolytic Cells

Parameter	Galvanic Cell	Electrolytic Cell
Process	Spontaneous reaction	Non-spontaneous reaction
Energy Flow	Chemical $\rightarrow$ Electrical	Electrical $\rightarrow$ Chemical
Anode Charge	Negative (-)	Positive (+)
Cathode Charge	Positive (+)	Negative (-)



The Daniell cell naturally operates as a Galvanic cell, but successfully transforms into an **Electrolytic cell** the moment an opposing external voltage exceeds 1.1 V.



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