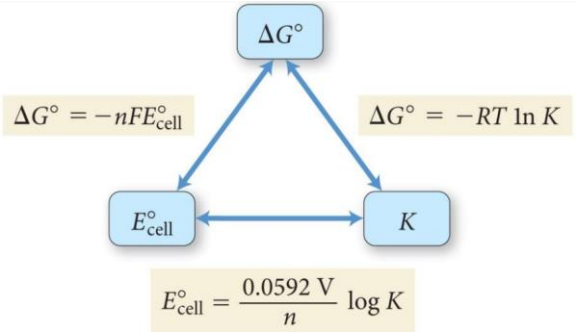
N45 – Variables Unite



In all electrochemical cells, oxidation occurs at the anode, reduction occurs at the cathode.

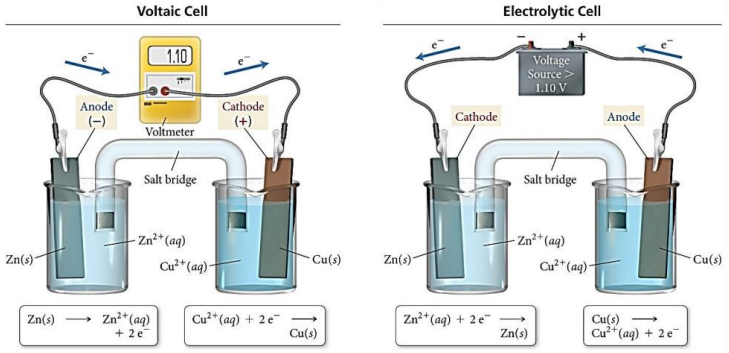
In voltaic cells

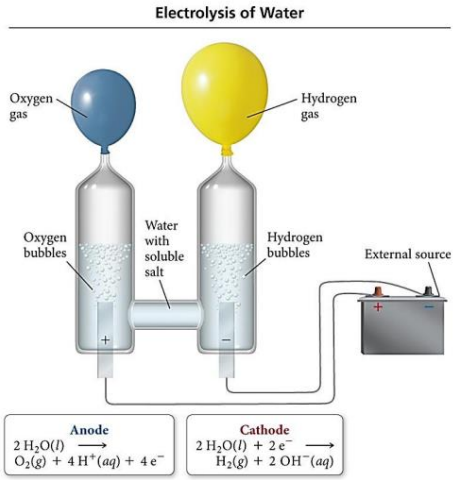
- Anode is the source of electrons and has a (−) charge.
- Cathode draws electrons and has a (+) charge.

In electrolytic cells

- Electrons are drawn off the anode, so it must have a place to release the electrons—the positive terminal of the battery.
- Electrons are forced toward the anode, so it must have a source of electrons—the negative terminal of the battery.

Voltaic versus Electrolytic Cells





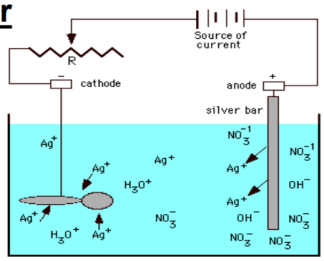
Electroplating of Silver

Anode reaction:

Ag → Ag⁺ + e⁻

Cathode reaction:

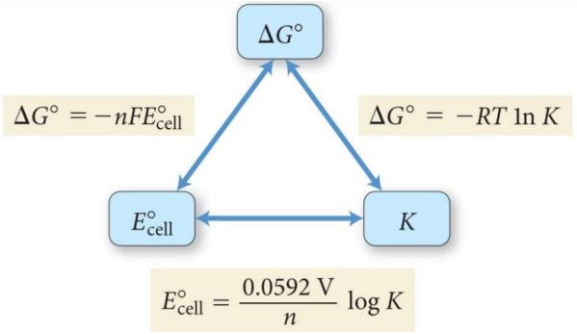
Ag⁺ + e⁻ → Ag



Electroplating requirements:

1. Solution of the plating metal
2. Anode made of the plating metal
3. Cathode with the object to be plated
4. Source of current

N45 - Variables Unite



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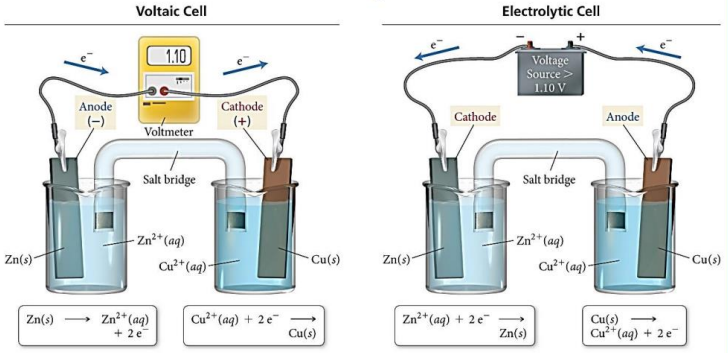

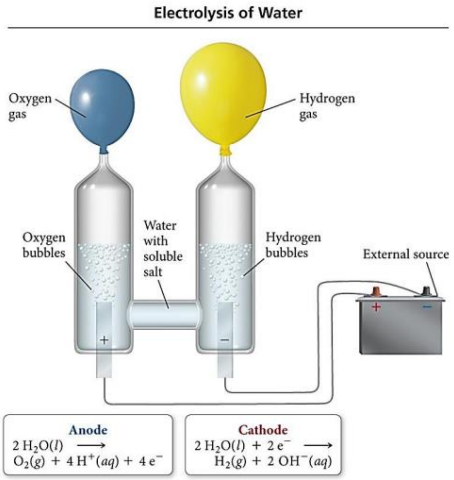

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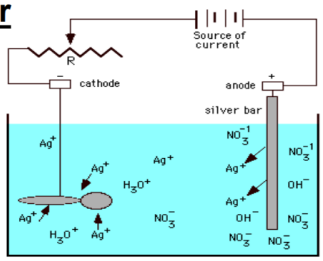

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Standard Conditions and Nonstandard Conditions for the Zn/Cu Galvanic Cell

Equation	$E°$	$\Delta G°$	K
$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$	+1.10 V	–212 kJ/mol	1.5×10^{37}

$$E = E^{o} - \frac{RT}{nF} \ln Q \qquad Q = \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Farther Away From Equilibrium than Standard Conditions	Standard Conditions	Closer To Equilibrium than Standard Conditions	At Equilibrium The cell is "dead"
$Q < 1$	$Q = 1$	$Q > 1$	$Q = K = 1.5 \times 10^{37}$
$E > E°$	$E = E°$	$E < E°$	E = zero
$[Zn^{2+}] < [Cu^{2+}]$ decreased [product] or increased [reactant] compared to standard conditions	$[Zn^{2+}] = [Cu^{2+}]$ [product] = [reactant]	$[Zn^{2+}] > [Cu^{2+}]$ increased [product] or decreased [reactant] compared to standard conditions	$[Zn^{2+}] >> [Cu^{2+}]$

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