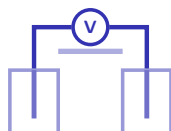


Electrochemistry

A-Level Chemistry ■ Topic 24

A-Level Chemistry



Electrochemistry

What we will cover

- 1 Electrolysis
- 2 Faraday calculations
- 3 Standard electrode potentials
- 4 Cell potentials & feasibility
- 5 The Nernst equation

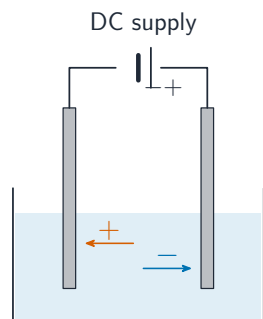


electrolysis of water

1

Electrolysis

Electrolysis

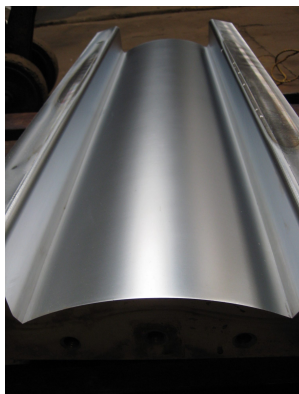


cathode (-) reduction
anode (+) oxidation

Electrolysis 电解 breaks down an **electrolyte** 电解质:

- **cathode** 阴极 (-): positive ions gain e^- (reduction)
- **anode** 阳极 (+): negative ions lose e^- (oxidation)

Faraday calculations



Charge $Q = It$; moles of electrons $= Q/F$
(**Faraday constant** 法拉第常量).

2.0 A for 30 min through CuSO_4

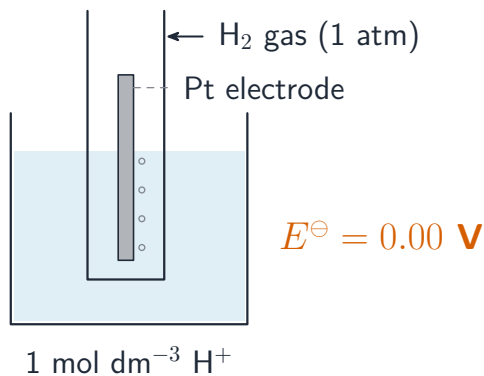
$Q = 3600 \text{ C}$; $n(e^-) = 0.0373$; $n(\text{Cu}) = 0.0187$
 $\Rightarrow m \approx 1.2 \text{ g}$

Use the half-equation to find moles of product.

2

Electrode potentials

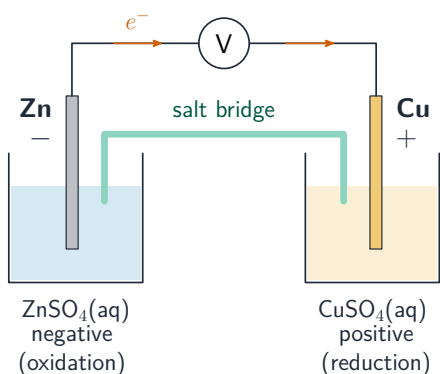
Standard electrode potentials



The **standard electrode potential** 标准电极电势 $E^\ominus$ shows how easily a half-cell is reduced.

It is measured against the **standard hydrogen electrode** 标准氢电极, defined as exactly 0.00 V.

Cell potentials and feasibility



$$E_{\text{cell}}^\ominus = E^\ominus(\text{more+}) - E^\ominus(\text{less+}).$$

$$\text{Zn } (-0.76) \text{ \& Cu } (+0.34)$$

$$E_{\text{cell}}^\ominus = 0.34 - (-0.76) = 1.10 \text{ V}$$

A reaction is **feasible** 可行 when $E_{\text{cell}}^\ominus > 0$. ($\Delta G^\ominus = -nE^\ominus F$)

The electrochemical series

$E^\ominus / \text{V}$	
+2.87	F ₂ /F ⁻
+1.36	Cl ₂ /Cl ⁻
+0.34	Cu ²⁺ /Cu
0.00	2H ⁺ /H ₂
-0.76	Zn ²⁺ /Zn
-2.71	Na ⁺ /Na

↑ stronger oxidising agent

↓ stronger reducing agent

■ a more **positive** $E^\ominus \rightarrow$ a stronger **oxidising agent** 氧化剂 (easily reduced)

■ a more **negative** $E^\ominus \rightarrow$ a stronger **reducing agent** 还原剂

The Nernst equation

$$E = E^{\ominus} + \frac{0.059}{z} \log \frac{[\text{oxidised}]}{[\text{reduced}]}$$

Away from standard conditions, raising the **oxidised** 氧化态 species' concentration makes E **more positive** (z = electrons in the half-equation).

3

Recap

Topic 24 – key takeaways

1 Electrolysis

cathode reduces; anode oxidises

2 Faraday

$$Q = It; \text{ moles of } e^- = Q/F$$

3 $E^{\ominus}$

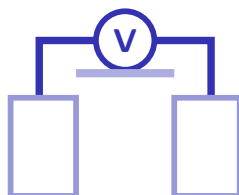
measured vs the hydrogen electrode (0 V)

4 Cells

$$E_{\text{cell}}^{\ominus} > 0 \text{ means feasible}$$

Check yourself

- 1 What happens at the cathode?
- 2 What is the charge Q equal to?
- 3 What is the SHE defined as?
- 4 A cell is feasible when $E_{\text{cell}}^{\ominus}$ is what?



Answers 1. reduction (positive ions gain e^-) 2. It 3. 0.00 V 4. positive