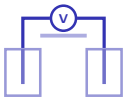
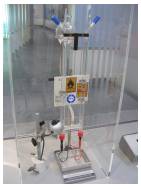
Electrochemistry

A-Level Chemistry ▪ Topic 24

A-Level Chemistry



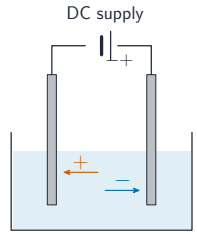
What we will cover



electrolysis of water

1 Electrolysis

Electrolysis

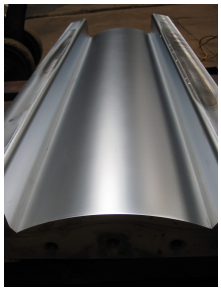


cathode (−) **anode** (+)
reduction oxidation

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).

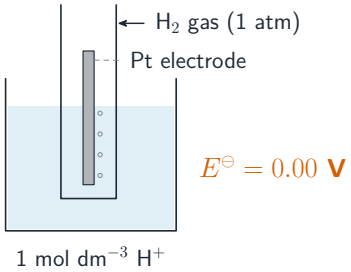
2.0 A for 30 min through $CuSO_4$

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

Use the half-equation to find moles of product.

2 Electrode potentials

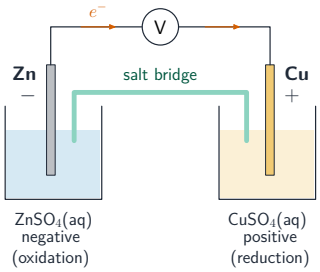
Standard electrode potentials



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 $0.00\,\text{V}$.

Cell potentials and feasibility



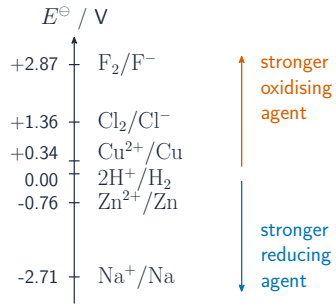
$E^\ominus_{\text{cell}} = E^\ominus(\text{more+}) - E^\ominus(\text{less+})$.

Zn (-0.76) & Cu ($+0.34$)

$E^\ominus_{\text{cell}} = 0.34 - (-0.76) = 1.10\,\text{V}$

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

The electrochemical series



- a more positive $E^\ominus$ → a stronger **oxidising agent** 氧化剂 (easily reduced)
- a more negative $E^\ominus$ → 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).

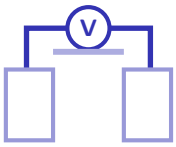
3 Recap

Topic 24 – key takeaways

1. **Electrolysis**
   cathode reduces; anode oxidises
2. **Faraday**
   $Q = It$; moles of $e^- = Q/F$
3. **$E^\ominus$**
   measured vs the hydrogen electrode (0 V)
4. **Cells**
   $E^\ominus_{\text{cell}} > 0$ 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 $E^{\ominus}_{\text{cell}}$ is what?



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