

24.1 Electrolysis

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS electrolysis 电解 • avogadro constant 阿伏伽德罗常量
 • faraday constant 法拉第常量 • electrolyte 电解质 • cathode 阴极

Objective

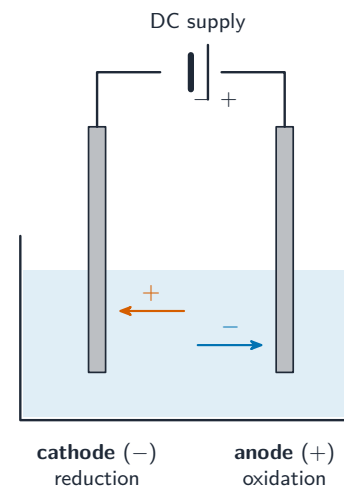
Build the skills to answer exam questions on **electrolysis** 电解 — predicting the products, the **Faraday constant** 法拉第常量, and electrolysis calculations.

You must be able to:

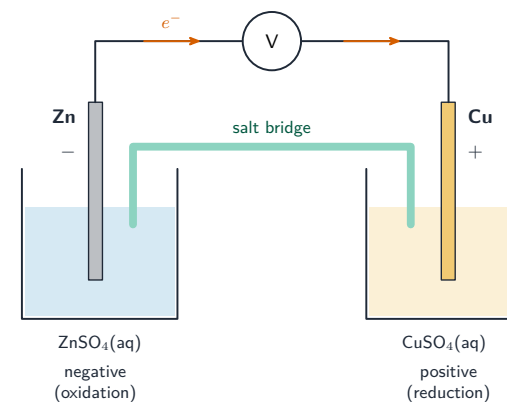
- predict the products of electrolysis (molten or aqueous, from the redox series)
- use $F = Le$ and $Q = It$
- calculate the mass or volume of substance liberated

1 Worked examples

■ Electrolysis and its products



Cathode (-): positive ions gain electrons (reduction). Anode (+): negative ions lose electrons (oxidation)



Electrolysis is the reverse of an electrochemical cell

A **molten** electrolyte gives the metal (cathode) and non-metal (anode). An **aqueous** one: a reactive metal gives H_2 instead at the cathode; the anode gives O_2 unless a concentrated halide gives the halogen.

■ Calculations

$F = Le$ (Faraday = Avogadro $\times$ electron charge). $Q = It$, then: moles of $e^- = Q/F$
 $\rightarrow$ moles of product (from the half-equation) $\rightarrow$ mass or volume.

Example. 2.0 A for 30 min through CuSO_4 ($\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$): $Q = 2.0 \times 1800 = 3600$ C; $\text{mol } e^- = 3600/96500 = 0.0373$; $\text{mol Cu} = 0.0187$; $m = 0.0187 \times 64 = 1.2$ g.

2 Practice

2.1 State what is formed at the cathode and anode when **molten** sodium chloride is electrolysed. [2]

2.2 Write the relationship between the Faraday constant, the Avogadro constant and the electron charge. [1]

3 Exam-style questions

3.1 At the cathode during electrolysis, positive ions are: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** oxidised (lose electrons)
B reduced (gain electrons)
C neutralised
D unchanged

3.2 What charge passes when a current of 1.5 A flows for 200 s? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** 130 C
B 300 C
C 0.0075 C
D 3.0 C

3.3 A current of 0.50 A flows for 1 hour through silver nitrate solution: $\text{Ag}^+ + e^- \rightarrow \text{Ag}$. ($F = 96\,500$ C mol $^{-1}$, A_r Ag = 108.)

(a) Calculate the charge passed. [1]

(b) Calculate the mass of silver deposited at the cathode. [3]

3.4 Explain why electrolysing **aqueous** sodium chloride gives hydrogen at the cathode, not sodium. [2]