

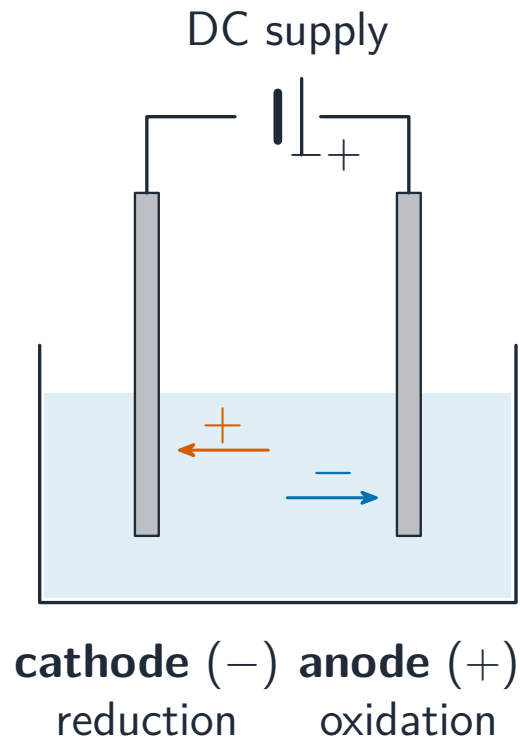
Exercise walk-through

24.1

Electrolysis

A-Level Chemistry

Electrolysis

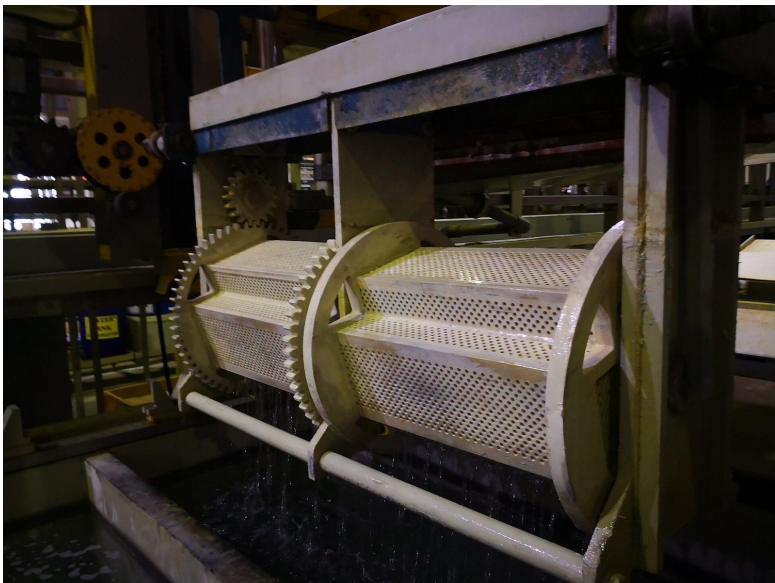


Electrolysis

breaks down an **electrolyte** :

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

Faraday calculations



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

2.0 A for 30 min through CuSO_4

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

Use the half-equation to find moles of product.

From charge to mass, and back to Avogadro

the charge

$Q = It$ – current in amperes, time in seconds

to moles of electrons

divide by the Faraday constant, $96\,500\text{ C mol}^{-1}$

to moles of product

divide by the number of electrons in the **half-equation**
– 2 for $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$

to mass

multiply by the molar mass

a worked figure

2.0 A for 30 minutes is 3600 C, so 0.0373 mol of electrons and 0.0187 mol of copper – about 1.2 g

the Avogadro constant

measuring the mass deposited for a known charge lets you work back to a value for it

The half-equation's electron count is the step candidates omit. Write it down before dividing, every time.

Exercises 2.1·2.2

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]

Exercises 2.1·2.2

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

2.1

- cathode: sodium (metal); anode: chlorine

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

2.2

- $F = Le$

Exercises 3.1·3.2

3.1 At the cathode during electrolysis, positive ions are:

[1]

☐

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 130 C

B 300 C

C 0.0075 C

D 3.0 C

Exercises 3.1·3.2

3.1 At the cathode during electrolysis, positive ions are:

[1]

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

3.1 B

- Cations are reduced at the cathode

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

[1]

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

3.2 B

- $Q = It = 1.5 \times 200 = 300 \text{ C}$

Exercise 3.3 (a)

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

(a) Calculate the charge passed.

[1]

Exercise 3.3 (a)

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

(a) Calculate the charge passed.

[1]

(a)

- $Q = It = 0.50 \times 3600 = 1800 \text{ C}$

Exercise 3.3 (b)

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

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

Exercise 3.3 (b)

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

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

(b)

- $\text{mol } e^- = 1800/96500 = 0.01865$; $\text{Ag}^+ + e^- \rightarrow \text{Ag}$ so $\text{mol Ag} = 0.01865$; $m = 0.01865 \times 108 = 2.0 \text{ g}$

Exercise 3.4

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

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3.4

- sodium is too reactive (very negative electrode potential), so the water/ H^+ is reduced instead, releasing hydrogen