

4.1 Electrolysis

Name: _____ Class: _____ Date: _____

Total: 13 marks**KEY WORDS** electrodes • anode • aqueous • electrolysis • cathode

Objective

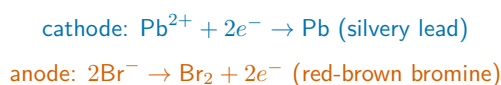
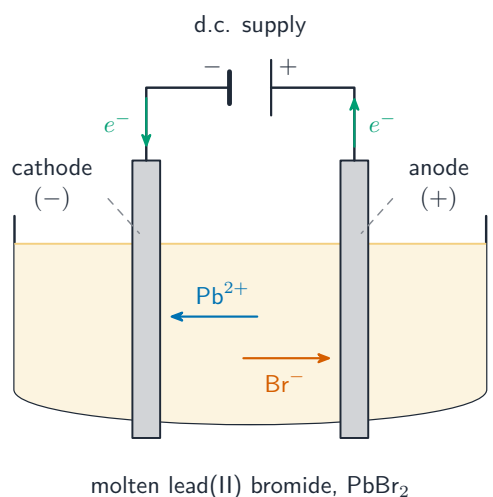
Build the skills to answer exam questions on **electrolysis** – the **electrolytic cell**, products at each electrode, **half-equations**, and **electroplating**.

You must be able to:

- name the anode/cathode and explain why the substance must be molten/aqueous
- predict the products and write half-equations (reduction at cathode, oxidation at anode)
- describe electroplating

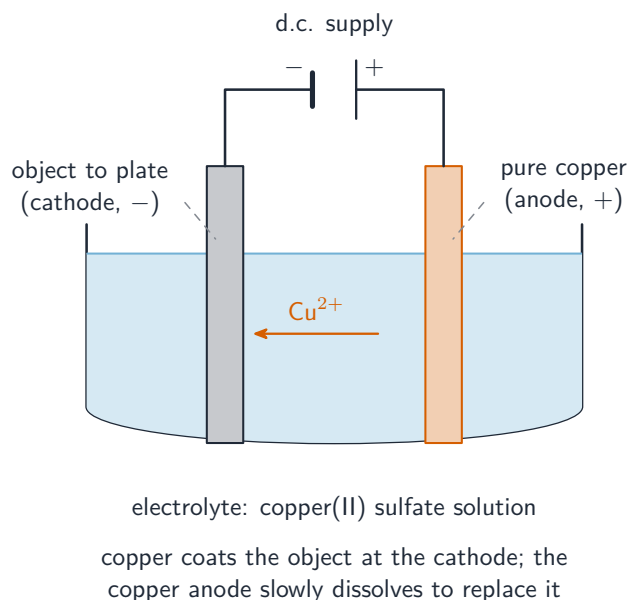
1 Key knowledge and worked examples

■ Electrolysis of molten PbBr_2



Positive ions go to the cathode (reduction), negative ions to the anode (oxidation)

- **cathode (–):** $\text{Pb}^{2+} + 2e^- \rightarrow \text{Pb}$ (reduction).
- **anode (+):** $2\text{Br}^- \rightarrow \text{Br}_2 + 2e^-$ (oxidation).
- needs molten/aqueous so the ions are free to move.



To electroplate: object = cathode, plating metal = anode, in a solution of the plating-metal ions

2 Practice

2.1 State why solid sodium chloride cannot be electrolysed.

[1]

2.2 Name the products at each electrode when molten lead(II) bromide is electrolysed.[2]

3 Exam-style questions

3.1 At the cathode during electrolysis, positive ions:

[1]

☐

- A lose electrons (oxidation)
- B gain electrons (reduction)
- C stay unchanged
- D become anions

3.2 Dilute sulfuric acid is electrolysed using inert carbon electrodes.

(a) Name the gas formed at each electrode, and state the ratio of their volumes. [3]

(b) Write the half-equation for the reaction at the cathode, and explain why the ions in the water are discharged rather than the sulfate ions. [3]

3.3 Describe how you would electroplate an iron spoon with silver. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- in the solid the ions are **locked in place** and cannot move to carry the charge

2.2

- cathode (negative): **lead**
- anode (positive): **bromine**

3.1 B

- at the cathode, positive ions **gain electrons (reduction)**
- A is oxidation at the anode; C and D are wrong

3.2

(a)

- anode: **oxygen**
- cathode: **hydrogen**
- volume ratio $\text{H}_2 : \text{O}_2 = 2 : 1$

(b)

- $2\text{H}^+ + 2e^- \rightarrow \text{H}_2$
- H^+ is lower than sulfate in the discharge order, so sulfate **stays in solution**

3.3

- make the spoon the **cathode**
- make **silver** the anode
- use a solution containing **silver ions** as the electrolyte