

4.1 Electrolysis

Name: _____ Class: _____ Date: _____

Total: 13 marks**KEY WORDS** aqueous 水溶液 • electrodes 电极 • anode 阳极 • half-equation 半反应式 • cathode 阴极

Objective

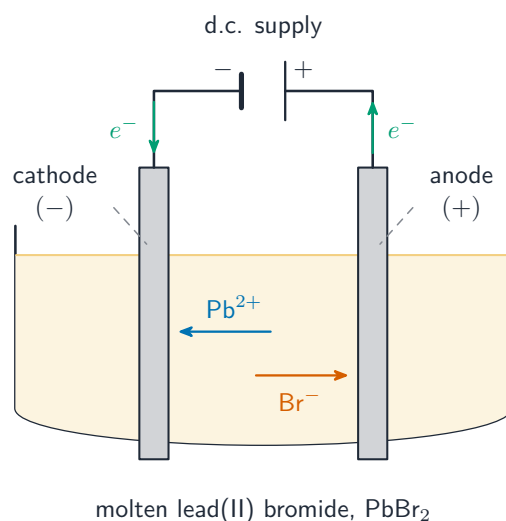
Build the skills to answer exam questions on **electrolysis** 电解 — the **electrolytic cell** 电解池, products at each electrode, **half-equations** 半反应式, and **electroplating** 电镀.

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 Worked examples

■ Electrolysis of molten PbBr_2

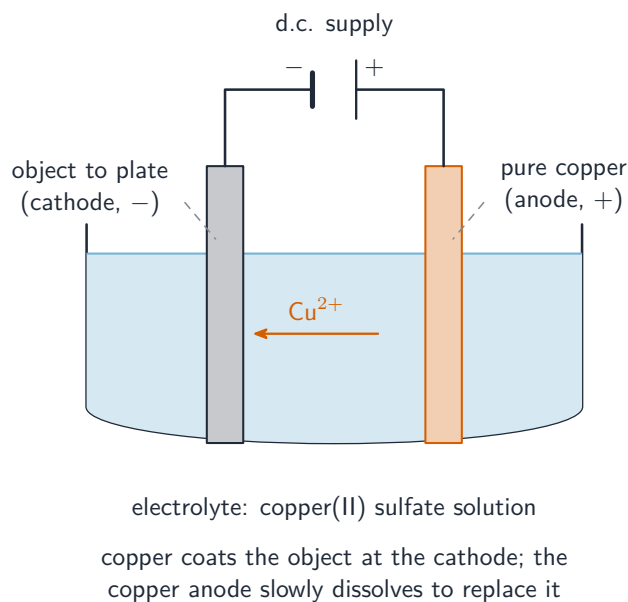


cathode: $\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$ (silvery lead)

anode: $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$ (red-brown bromine)

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
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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

2.1 its ions are locked in place and cannot move to carry the charge.

2.2 lead at the cathode; bromine at the anode.

3.1 B. At the cathode, positive ions gain electrons (reduction).

3.2 (a) Oxygen at the anode; hydrogen at the cathode; twice as much hydrogen as oxygen, a ratio of 2 : 1.

(b) $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$; hydrogen ions are lower than sulfate in the discharge order, so they accept electrons in preference, and the sulfate ions stay in solution.

3.3 make the spoon the cathode; make silver the anode; use a solution containing silver ions as the electrolyte.