Exercise walk-through

Electrolysis ▪ 4.1

eXercise

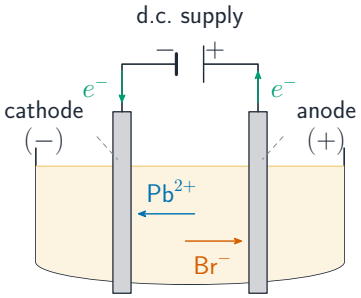
You must be able to

- 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

Method — Electrolysis of molten $PbBr_2$

- **cathode (−):** $Pb^{2+} + 2e^- \rightarrow Pb$ (reduction).
- **anode (+):** $2Br^- \rightarrow Br_2 + 2e^-$ (oxidation).
- needs molten/aqueous so the ions are free to move.

Method — Electrolysis of molten $PbBr_2$



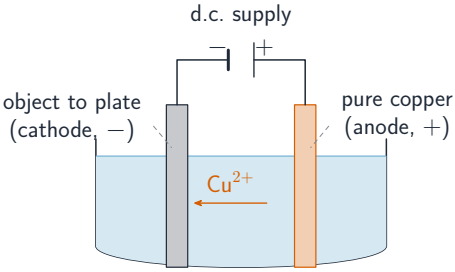
molten lead(II) bromide, $PbBr_2$

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

anode: $2Br^- \rightarrow Br_2 + 2e^-$ (red-brown bromine)

An electrolysis cell: Pb^{2+} to the cathode, Br^- to the anode

Method — Electrolysis of molten $PbBr_2$



electrolyte: copper(II) sulfate solution
copper coats the object at the cathode; the copper anode slowly dissolves to replace it

An electroplating cell: object = cathode, plating metal = anode

Practice 2.1 ▪ 1 mark

State why solid sodium chloride cannot be electrolysed.

Solution 2.1

Worked steps

its ions are locked in place and cannot move to carry the charge B1.

Practice 2.2 ▪ 2 marks

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

Solution 2.2

Worked steps

lead at the cathode B1; bromine at the anode B1.

Exam-style 3.1 ▪ 1 mark

At the cathode during electrolysis, positive ions:

A lose electrons (oxidation)

B gain electrons (reduction)

C stay unchanged

D become anions

Solution 3.1

Method: Electrolysis of molten $PbBr_2$

A lose electrons (oxidation)

B gain electrons (reduction) ✓

C stay unchanged

D become anions

Worked steps

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

Exam-style 3.2 ▪ 3 marks

Dilute sulfuric acid is electrolysed using inert carbon electrodes.
(a) Name the gas formed at each electrode, and state the ratio of their volumes.
(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.

Solution 3.2

Method: Electrolysis of molten $PbBr_2$

Worked steps

(a) Oxygen at the anode **B1**; hydrogen at the cathode **B1**; twice as much hydrogen as oxygen, a ratio of 2 : 1 **B1**.

(b) $2H^+ + 2e^- \rightarrow H_2$ **M1** **A1**; hydrogen ions are lower than sulfate in the discharge order, so they accept electrons in preference, and the sulfate ions stay in solution **B1**.

Exam-style 3.3 ▪ 3 marks

Describe how you would electroplate an iron spoon with silver.

Solution 3.3

Worked steps

make the spoon the cathode M1; make silver the anode M1; use a solution containing silver ions as the electrolyte A1.