

Exercise walk-through

20.1

Redox and electrolysis

International Baccalaureate · IB Diploma · Chemistry · HL

20.1 Redox and electrolysis

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS oxidation • reduction

Objective

Redox and electrolysis. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

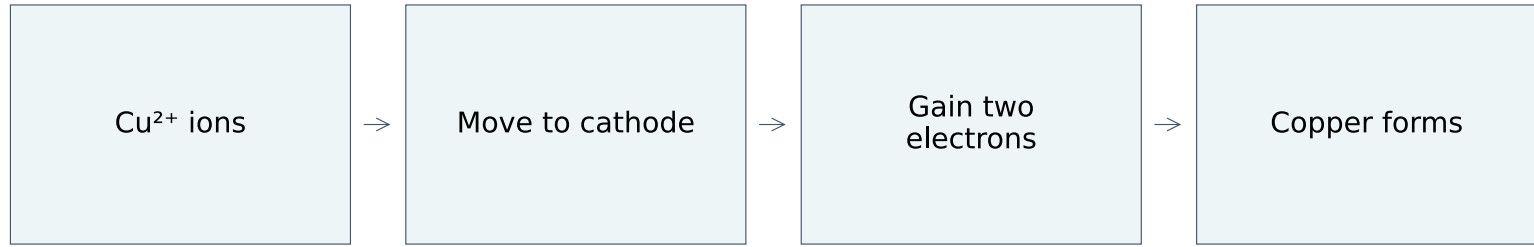
1 Key knowledge and worked examples

■ What would explain this observation?

- An aqueous salt solution can produce different electrode products from the molten salt. Water introduces competing species into the system.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ Build the model

- **Oxidation** is loss of electrons and **reduction** is gain of electrons. In electrolysis, cations move toward the cathode and anions toward the anode. Reduction occurs at the cathode.
- oxidation: Loss of electrons; reduction: Gain of electrons.



■ Choose evidence that can test it

- Predict products using the specified electrolyte and electrode material. In an aqueous solution, hydrogen or oxygen may form because water-related species compete. Molten salts contain only the ions of the salt.
 - Use a low-voltage direct-current supply, approved electrodes, and the school risk assessment. Collect gases only by an approved method. Keep chlorine demonstrations teacher-controlled; do not ask students to generate hazardous gases independently.
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■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.

- Known: a copper ion gains two electrons. Half-equation: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$. One mole of Cu^{2+} requires two moles of electrons. For 0.050 mol of copper, electron amount $= 2 \times 0.050 = 0.100$ mol.

Example:

How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper? Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Electrode signs depend on the cell type. In an electrolytic cell the cathode is negative; reduction remains the defining process at a cathode in every cell.
- Return to the original observation. Explain what the result supports, which conditions

it assumes, and one way to test a competing explanation.

Warn:

Reduction means loss of electrons. This claim is false: Electrode signs depend on the cell type. In an electrolytic cell the cathode is negative; reduction remains the defining process at a cathode in every cell.

Key:

Redox and electrolysis: Predict products using the specified electrolyte and electrode material. In an aqueous solution, hydrogen or oxygen may form because water-related species compete. Molten salts contain only the ions of the salt.

Exercises 2.1·2.3

2.1 What happens to Cu^{2+} at the cathode? Choose one answer.

- **A** It gains electrons
- **B** It loses two protons
- **C** It gains neutrons

[1]

2.2 How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper? Show the relation,

2.3 Decide whether this claim is true and justify: Reduction means loss of electrons. [2]

Exercises 2.1·2.3

2.1 What happens to Cu^{2+} at the cathode? Choose one answer.

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- **B** It loses two protons
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[1]

2.1 A Predict products using the specified electrolyte and electrode material. In an aqueous solution, hydrogen or oxygen may form because water-related species compete. Molten salts contain only the ions of the salt.

2.2 How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper? Show the relation,

2.2 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$; electron amount = $2 \times 0.20 = 0.40$ mol.

2.3 Decide whether this claim is true and justify: Reduction means loss of electrons. [2]

2.3 False. Electrode signs depend on the cell type. In an electrolytic cell the cathode is negative; reduction remains the defining process at a cathode in every cell.

Exercises 2.4·3.1

2.4 Loss of electrons: write the technical term.

[1]

3.1 A fictional electrolytic cell deposits 0.15 mol Cu from Cu^{2+} . Find electron amount and write the half-equation. Explain whether cathode sign defines reduction.

[4]

Exercises 2.4·3.1

2.4 Loss of electrons: write the technical term. [1]

2.4 oxidation. oxidation means Loss of electrons.

3.1 A fictional electrolytic cell deposits 0.15 mol Cu from Cu^{2+} . Find electron amount and write the half-equation. Explain whether cathode sign defines reduction. [4]

3.1 0.30 molelectrons; $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$. Reduction is electron gain. The electrolytic cathode is negative, but electrode signs depend on cell type; the process defines the name.