20.1 Redox and electrolysis

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS oxidation • reduction

Objective

Redox and electrolysis. Original classroom practice for IB HL; not an official IB paper.

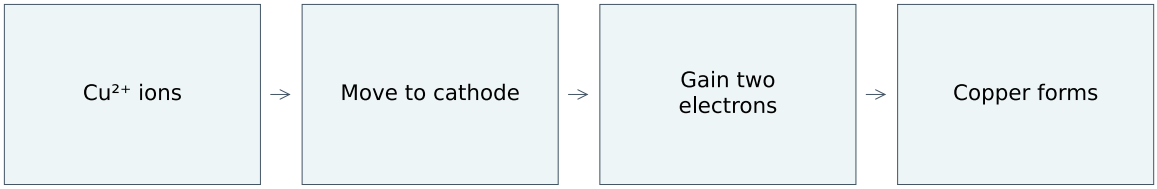
1 Key knowledge and worked examples

■ 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.

■ 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.

In the lab: 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.

Work from known quantities

- Known: a copper ion gains two electrons.
- Half-equation: $Cu^{2+} + 2e^- \rightarrow Cu$.
- 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.

Your turn: How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper?

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.

Not true: Reduction means loss of electrons. Reduction is defined as gain of electrons (OILRIG: oxidation is loss, reduction is gain). At a cathode, reduction occurs in every cell type, whatever the electrode sign.

Key:

- Oxidation is loss of electrons and reduction is gain of electrons.
- Predict products using the specified electrolyte and electrode material.
- Watch for: electrode signs depend on the cell type.

Write from 0.50 mol of electrons

- The half-equation is Cu2+ plus 2e- to Cu.
- Find the electron amount that reduces 0.25 mol of copper(II) ions. Reduction is gain of electrons.

2 Practice

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

- **A** It loses two protons
- **B** It gains electrons
- **C** It gains neutrons [1]

2.2 How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper? Show the relation, substitution and units. [2]

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

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

3 Exam-style questions

3.1 A fictional electrolytic cell deposits0.15 molCu fromCu^{2+}. Find electron amount and write the half-equation. Explain whether cathode sign defines reduction. [4]

Solutions

2.1 B The cathode is where reduction happens: Cu2+ gains two electrons and becomes copper metal, Cu2+ + 2e- -> Cu. Ions do not gain neutrons, and losing protons would change the element, which chemistry cannot do.

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

2.3 False. Reduction is defined as gain of electrons (OILRIG: oxidation is loss, reduction is gain). At a cathode, reduction occurs in every cell type, whatever the electrode sign.

2.4 oxidation. oxidation means Loss of electrons.

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