

**12** Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which statement is correct?

- A** Oxygen gas is produced at the positive electrode.
- B** The blue colour of the solution gradually fades.
- C** The concentration of copper ions in the solution stays the same.
- D** The mass of the negative electrode decreases.

**13** Which row describes the reactions during the electrolysis of dilute aqueous sodium chloride?

|          | anode reaction                                                            | cathode reaction                                                          |
|----------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <b>A</b> | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$                        | $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$ |
| <b>B</b> | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$                        | $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$ |
| <b>C</b> | $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$ | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$                        |
| <b>D</b> | $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$ | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$                        |

**12** Hydrogen–oxygen fuel cells are used in electric cars.

Three statements about these fuel cells are listed.

- The process in the cell is called electrolysis.
- Water is broken down in the cell to produce hydrogen, oxygen and electricity.
- Water is the only chemical product formed in the reaction.

Which statements are correct?

- A** 1 and 2
- B** 1 and 3
- C** 2 only
- D** 3 only

**13** A solution of copper(II) sulfate can be electrolysed using copper electrodes or carbon electrodes.

Which statements are correct?

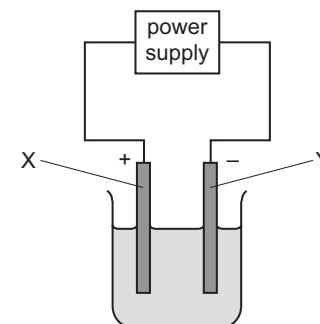
- Using copper electrodes, oxygen gas forms at the anode.
- Using copper electrodes, copper atoms lose electrons at the anode.
- Using carbon electrodes, copper metal forms at the cathode.
- Using carbon electrodes, copper ions gain electrons at the cathode.

- A** 1 and 2
- B** 1 and 3
- C** 2, 3 and 4
- D** 4 only

**13** Which product is initially obtained at each electrode during the electrolysis of concentrated aqueous sodium chloride?

|          | cathode  | anode    |
|----------|----------|----------|
| <b>A</b> | hydrogen | chlorine |
| <b>B</b> | hydrogen | oxygen   |
| <b>C</b> | sodium   | chlorine |
| <b>D</b> | sodium   | oxygen   |

**14** Molten lead(II) bromide is electrolysed using inert electrodes.



Which statement describes the movement of electrons?

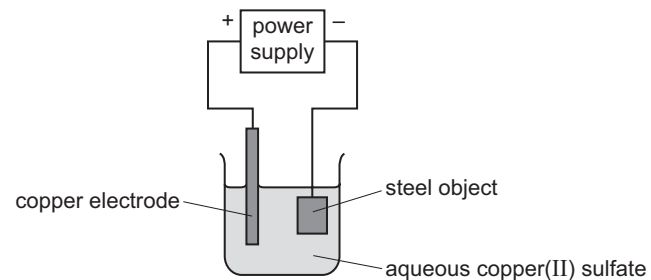
- A** from X to Y through the external wire
- B** from Y to X through the external wire
- C** from X to Y through the electrolyte
- D** from Y to X through the electrolyte

**15** In a fuel cell, a fuel is oxidised to produce electricity.

Which row describes the fuel and the oxidising agent used?

|          | fuel     | oxidising agent |
|----------|----------|-----------------|
| <b>A</b> | nitrogen | oxygen          |
| <b>B</b> | hydrogen | oxygen          |
| <b>C</b> | nitrogen | water           |
| <b>D</b> | hydrogen | water           |

10 The diagram shows the electroplating of a steel object.



A student makes three statements.

- 1 The steel object turns a reddish-brown colour.
- 2 The aqueous copper(II) sulfate changes to a paler blue colour.
- 3 The copper electrode becomes thinner.

Which statements are correct?

- A** 1, 2 and 3     **B** 1 and 2 only     **C** 1 and 3 only     **D** 2 and 3 only

11 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which equation shows the correct ionic half-equation for the reaction at the anode?

- A**  $\text{Cl}^- + \text{e}^- \rightarrow \text{Cl}$
- B**  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
- C**  $\text{H}^+ \rightarrow \text{H} + \text{e}^-$
- D**  $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

12 Which equation represents the overall reaction in a hydrogen–oxygen fuel cell?

- A**  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- B**  $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
- C**  $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$
- D**  $\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$