

Week 9

IGCSE Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

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IGCSE Chemistry

Name: _____ Score: _____

1. Electrolysis is the breaking down of a compound using:
 - ☐ an electric current
 - ☐ heat only
 - ☐ light
 - ☐ a catalyst
2. In OIL RIG, oxidation is:
 - ☐ loss of electrons
 - ☐ gain of electrons
 - ☐ loss of protons
 - ☐ gain of neutrons
3. Electrolysing copper sulfate with copper electrodes is used to:
 - ☐ purify copper
 - ☐ make oxygen
 - ☐ electroplate silver
 - ☐ produce sodium
4. The only product of a hydrogen–oxygen fuel cell is:
 - ☐ water
 - ☐ carbon dioxide
 - ☐ methane
 - ☐ oxygen
5. Positive ions move towards the:
 - ☐ cathode (negative electrode)
 - ☐ anode (positive electrode)
 - ☐ electrolyte
 - ☐ power supply
6. Why is electroplating used? (Select all that apply.)
 - ☐ to improve appearance
 - ☐ to protect from corrosion

☐ to make a cheap object look expensive

☐ to melt the object

Tick every correct option.

7. Negative ions move towards the positive anode.

☐ True ☐ False

8. Reduction is the gain of electrons.

☐ True ☐ False

9. In electroplating, the plating metal forms the anode.

☐ True ☐ False

10. A drawback of fuel cells is that hydrogen is difficult to store and transport.

☐ True ☐ False

IGCSE Chemistry

1. **an electric current**

An electric current decomposes the electrolyte.

2. **loss of electrons**

Oxidation Is Loss of electrons.

3. **purify copper**

The impure copper anode dissolves; pure copper deposits on the cathode.

4. **water**

Hydrogen + oxygen $\rightarrow$ water.

5. **cathode (negative electrode)**

Opposite charges attract: positive ions $\rightarrow$ negative cathode.

6. **to improve appearance; to protect from corrosion; to make a cheap object look expensive**

Electroplating coats, not melts.

7. **True**

Anions are attracted to the anode.

8. **True**

Reduction Is Gain (RIG).

9. **True**

The anode supplies the metal that coats the cathode.

10. **True**

Hydrogen storage is a major challenge.

4.1 Electrolysis

Name: _____ Class: _____ Date: _____

Total: 11 marks**KEY WORDS** aqueous 水溶液 • electrodes 电极 • anode 阳极 • half-equation 半反应式 • cathode 阴极

Objective

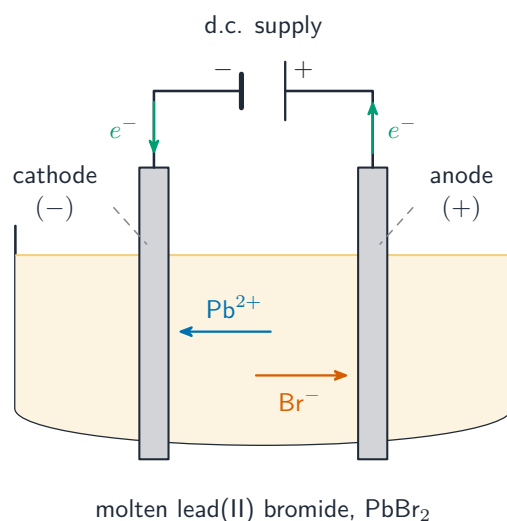
Build the skills to answer exam questions on **electrolysis** 电解 — the **electrolytic cell** 电解池, products at each electrode, **half-equations** 半反应式, and **electroplating** 电镀.

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

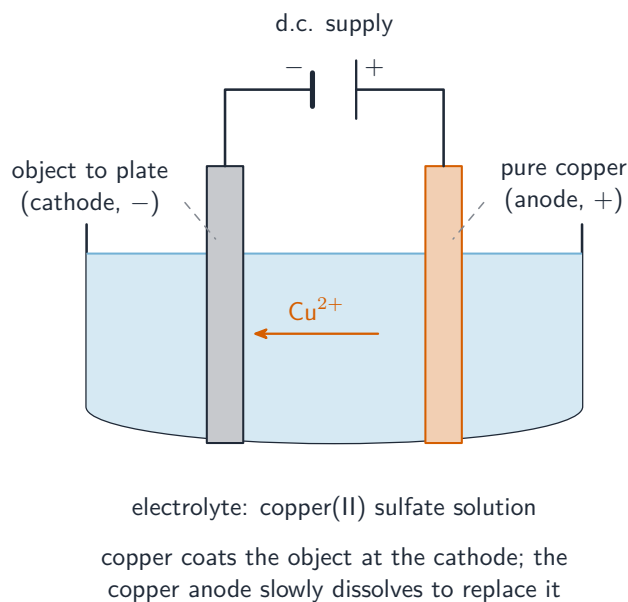


cathode: $\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$ (silvery lead)

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
-

3.2 Concentrated aqueous sodium chloride is electrolysed with inert electrodes.

(a) Name the gas formed at the anode and at the cathode. [2]

(b) Write the half-equation for the reaction at the cathode. [2]

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) chlorine at the anode; hydrogen at the cathode.

(b) $2\text{H}^+ + 2e^- \rightarrow \text{H}_2$.

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

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
A	$\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$	$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$
B	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
C	$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$	$\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
D	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

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

Which statements are correct?

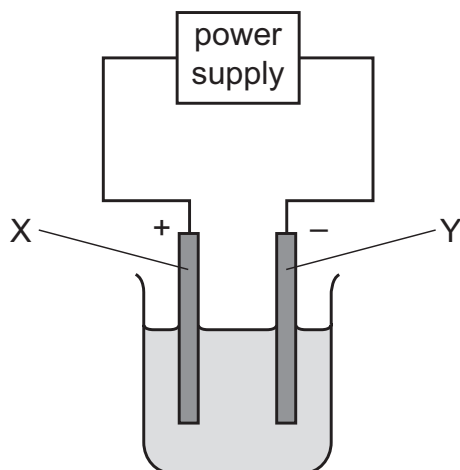
- 1 Using copper electrodes, oxygen gas forms at the anode.
- 2 Using copper electrodes, copper atoms lose electrons at the anode.
- 3 Using carbon electrodes, copper metal forms at the cathode.
- 4 Using carbon electrodes, copper ions gain electrons at the cathode.

- 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
A	hydrogen	chlorine
B	hydrogen	oxygen
C	sodium	chlorine
D	sodium	oxygen

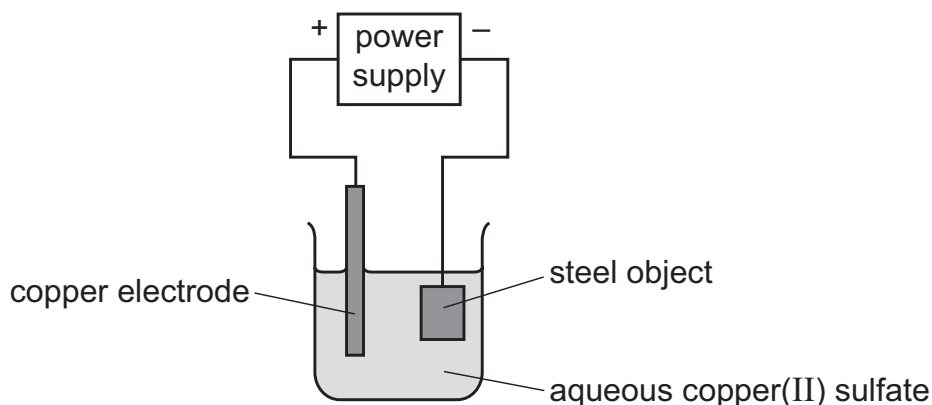
14 Molten lead(II) bromide is electrolysed using inert electrodes.



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

10 The diagram shows the electroplating of a steel object.



A student makes three statements.

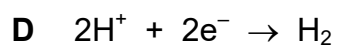
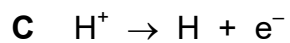
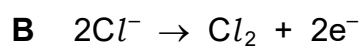
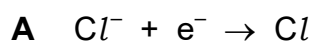
- 1 The steel object turns a reddish-brown colour.
- 2 The aqueous copper(II) sulfate changes to a paler blue colour.
- 3 The copper electrode becomes thinner.

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?



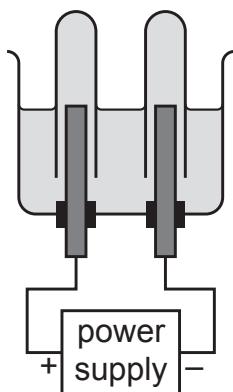
3 This question is about electrolysis.

- (a)** Complete the definition of electrolysis by filling in the missing words.

The decomposition of compounds when
or by the passage of an electric current.

[3]

- (b)** Electrolysis of aqueous copper(II) sulfate is carried out using the apparatus shown in Fig. 3.1. The electrodes are made of platinum.

**Fig. 3.1**

- (i)** State whether the mass of the cathode increases, decreases or remains the same when platinum electrodes are used.

..... [1]

- (ii)** Describe the change in appearance, if any, of the electrolyte when platinum electrodes are used.

..... [1]

- (iii)** Describe what is seen at the anode when platinum electrodes are used.

..... [1]

- (iv)** Write the ionic half-equation for the reaction at the anode.

..... [3]

- (c)** The electrolysis is repeated using copper electrodes.

- (i)** State whether the mass of the cathode increases, decreases or remains the same when copper electrodes are used.

..... [1]

- (ii)** Describe the change in appearance, if any, of the electrolyte when copper electrodes are used.

..... [1]

(d) Aluminium is extracted from its purified ore by electrolysis.

(i) Name this ore of aluminium.

..... [1]

(ii) Name the substance added to this process to reduce the operating temperature.

..... [1]

(iii) Explain why the anodes need to be continually replaced during this process.

.....

..... [2]

[Total: 15]

14 Dilute sulfuric acid is electrolysed using inert electrodes.

What are the ionic half-equations for the reactions that take place at each electrode?

	positive electrode	negative electrode
A	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
B	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- + 4\text{H}^+ \rightarrow 4\text{H}_2\text{O}$
C	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
D	$4\text{OH}^- + 4\text{H}^+ \rightarrow 4\text{H}_2\text{O}$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

4.2 Hydrogen-oxygen fuel cells

Name: _____ Class: _____ Date: _____

Total: 7 marks

KEY WORDS fuel cell 燃料电池 • hydrogen-oxygen fuel cells 氢氧燃料电池 • pollutants 污染物 • hydrogen 氢气
• oxygen 氧气

Objective

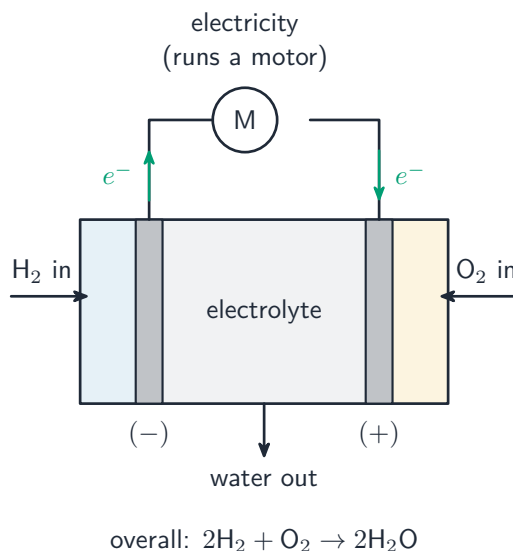
Build the skills to answer exam questions on **hydrogen-oxygen fuel cells** 氢氧燃料电池 — how they work and how they compare with a petrol engine.

You must be able to:

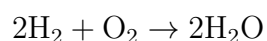
- give the overall reaction in a hydrogen-oxygen fuel cell
- state the advantages and disadvantages vs a petrol engine
- explain why the only product is water

1 Worked examples

■ The fuel cell



A fuel cell turns chemical energy straight into electricity; water is the only product



- **advantage:** only product is water — no air pollution.

- **disadvantage:** hydrogen is hard/dangerous to store; making it may use fossil fuels.

2 Practice

2.1 Write the overall equation for a hydrogen–oxygen fuel cell. [1]

2.2 State the only chemical product of the fuel cell. [1]

3 Exam-style questions

3.1 A key advantage of a hydrogen fuel cell over a petrol engine is that it: [1]

- **A** is easier to refuel
 - **B** produces only water, not pollutants
 - **C** uses no energy
 - **D** stores its fuel more easily
-

3.2 Compare a hydrogen–oxygen fuel cell with a petrol engine.

(a) Give one advantage of the fuel cell. [1]

(b) Give one disadvantage of the fuel cell. [1]

3.3 Explain why using a hydrogen fuel cell may still cause some pollution overall. [2]

Solutions

2.1 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$.

2.2 water.

3.1 B. It produces only water, not pollutants.

3.2 (a) the only product is water, so it does not pollute the air.

(b) hydrogen is hard/dangerous to store and transport.

3.3 the hydrogen fuel is often made using energy from fossil fuels; burning those fuels releases pollutants/carbon dioxide elsewhere.

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

Three statements about these fuel cells are listed.

- 1 The process in the cell is called electrolysis.
- 2 Water is broken down in the cell to produce hydrogen, oxygen and electricity.
- 3 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

IGCSE Chemistry: **w25 23**

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
A	nitrogen	oxygen
B	hydrogen	oxygen
C	nitrogen	water
D	hydrogen	water

IGCSE Chemistry: **s25 21**

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** $\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$

IGCSE Chemistry: **s25 22**

12 Hydrogen–oxygen fuel cells can be used to power vehicles.

Which statement about hydrogen–oxygen fuel cells is correct?

- A** The equation for the overall reaction is $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$.
- B** The only chemical products are water and carbon dioxide.
- C** Chemical energy in the fuel is converted into electrical energy.
- D** The hydrogen used in hydrogen–oxygen fuel cells is a fossil fuel.

15 Which statements about hydrogen–oxygen fuel cells are correct?

- 1 They convert chemical energy into electrical energy.
- 2 Hydrogen is reduced in the fuel cells.
- 3 They do **not** produce any atmospheric pollutants.

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