

Week 8

IGCSE Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

Topic 4 quiz	2
Exercise sheet 4.1	5
Past-paper questions 4.1	9
Exercise sheet 4.2	14
Past-paper questions 4.2	17

4. Electrochemistry

Starter Quiz · 课前小测

IGCSE Chemistry

Name: _____ Score: _____

- Electrolysis is the breaking down of a compound using:
 - ☐ an electric current
 - ☐ heat only
 - ☐ light
 - ☐ a catalyst
- In OIL RIG, oxidation is:
 - ☐ loss of electrons
 - ☐ gain of electrons
 - ☐ loss of protons
 - ☐ gain of neutrons
- Electrolysing copper sulfate with copper electrodes is used to:
 - ☐ purify copper
 - ☐ make oxygen
 - ☐ electroplate silver
 - ☐ produce sodium
- The only product of a hydrogen-oxygen fuel cell is:
 - ☐ water
 - ☐ carbon dioxide
 - ☐ methane
 - ☐ oxygen
- Positive ions move towards the:
 - ☐ cathode (negative electrode)
 - ☐ anode (positive electrode)
 - ☐ electrolyte
 - ☐ power supply
- 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

4. Electrochemistry

Answers · 答案

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 → water.

5. cathode (negative electrode)

Opposite charges attract: positive ions → 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: 13 marks

KEY WORDS electrodes 电极 • anode 阳极 • aqueous 水溶液 • electrolysis 电解 • cathode 阴极

Objective

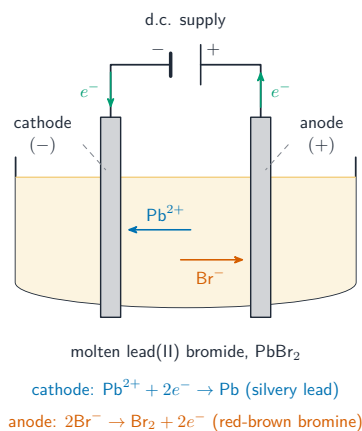
Build the skills to answer exam questions on **electrolysis** 电解 — the **electrolytic cell** 电解池, products at each electrode, **half-equations** 半反应式, and **electroplating** 电镀.

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

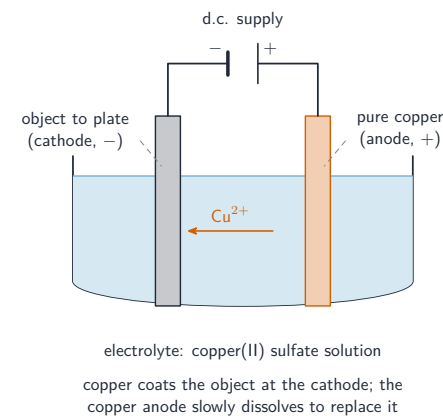
1 Worked examples

■ Electrolysis of molten PbBr_2



Positive ions go to the cathode (reduction), negative ions to the anode (oxidation)

- cathode** (–): $\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$ (reduction).
- anode** (+): $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$ (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 Dilute sulfuric acid is electrolysed using inert carbon electrodes.

(a) Name the gas formed at each electrode, and state the ratio of their volumes. [3]

(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. [3]

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

(b) $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$; hydrogen ions are lower than sulfate in the discharge order, so they accept electrons in preference, and the sulfate ions stay in solution.

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?

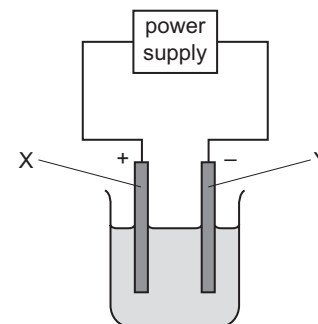
- Using copper electrodes, oxygen gas forms at the anode.
- Using copper electrodes, copper atoms lose electrons at the anode.
- Using carbon electrodes, copper metal forms at the cathode.
- Using carbon electrodes, copper ions gain electrons at the cathode.

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

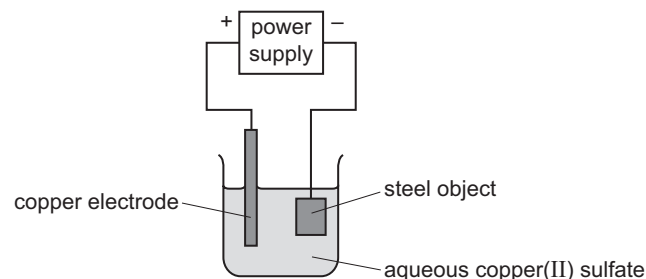
14 Molten lead(II) bromide is electrolysed using inert electrodes.



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.

- The steel object turns a reddish-brown colour.
- The aqueous copper(II) sulfate changes to a paler blue colour.
- 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 $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

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.

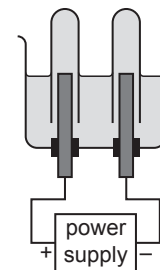


Fig. 3.1

- (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: 8 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

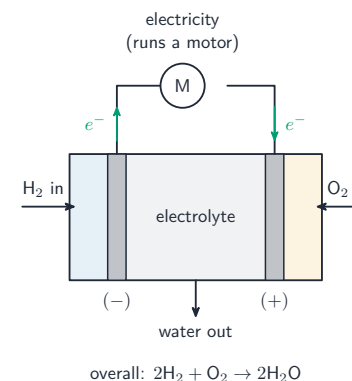
Build the skills to answer exam questions on **hydrogen-oxygen fuel cells** 氢氧燃料电池 — how they work and how they compare with a petrol engine.

You must be able to:

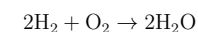
- give the overall reaction in a hydrogen-oxygen fuel cell
- state the advantages and disadvantages vs a petrol engine
- explain why the only product is water

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 A hydrogen–oxygen fuel cell takes in 4 g of hydrogen. Write the overall equation for the cell, and state the only product. [2]

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 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$; the only product is water, which is why the cell releases no carbon dioxide.

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

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

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

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