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شرح وحل الدرس الثالث Electrolysis منهج انسابير

موقع المناهج ← المناهج الإماراتية ← الصف الثاني عشر المتقدم ← كيمياء ← الفصل الثاني ← حلول ← الملف

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المزيد من مادة
كيمياء:

إعداد: Mouad

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

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التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة كيمياء في الفصل الثاني

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مناهج دولة الإمارات

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CHEMISTRY

“Electrochemistry” Lesson 3: “Electrolysis”

Mr. Mouad

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Inspire Chemistry

Module 19

“Electrochemistry”

Lesson 3: “Electrolysis”

Part 1



Learning objectives:

Describe how a spontaneous redox reaction of an electrochemical cell can be reversed

Define electrolysis, while relating the definition to the concept of spontaneity of redox reactions

Compare between electrolytic cell and voltaic cell in terms of identifying where will reduction and oxidation processes take place, anode, cathode, direction of electron flow and current flow and spontaneity of the reaction occurring.

Focus Questions

What are the differences between **Voltaic Cells and Electrolytic cells**?

How do electrolytic cells use energy to **drive nonspontaneous reactions**?

What are some of the **applications of Electrolytic cells**?

New Vocabulary

electrolysis

electrolytic cell

MAIN IDEA In electrolysis, a power source causes nonspontaneous reactions to occur in electrochemical cells.

Electrolysis

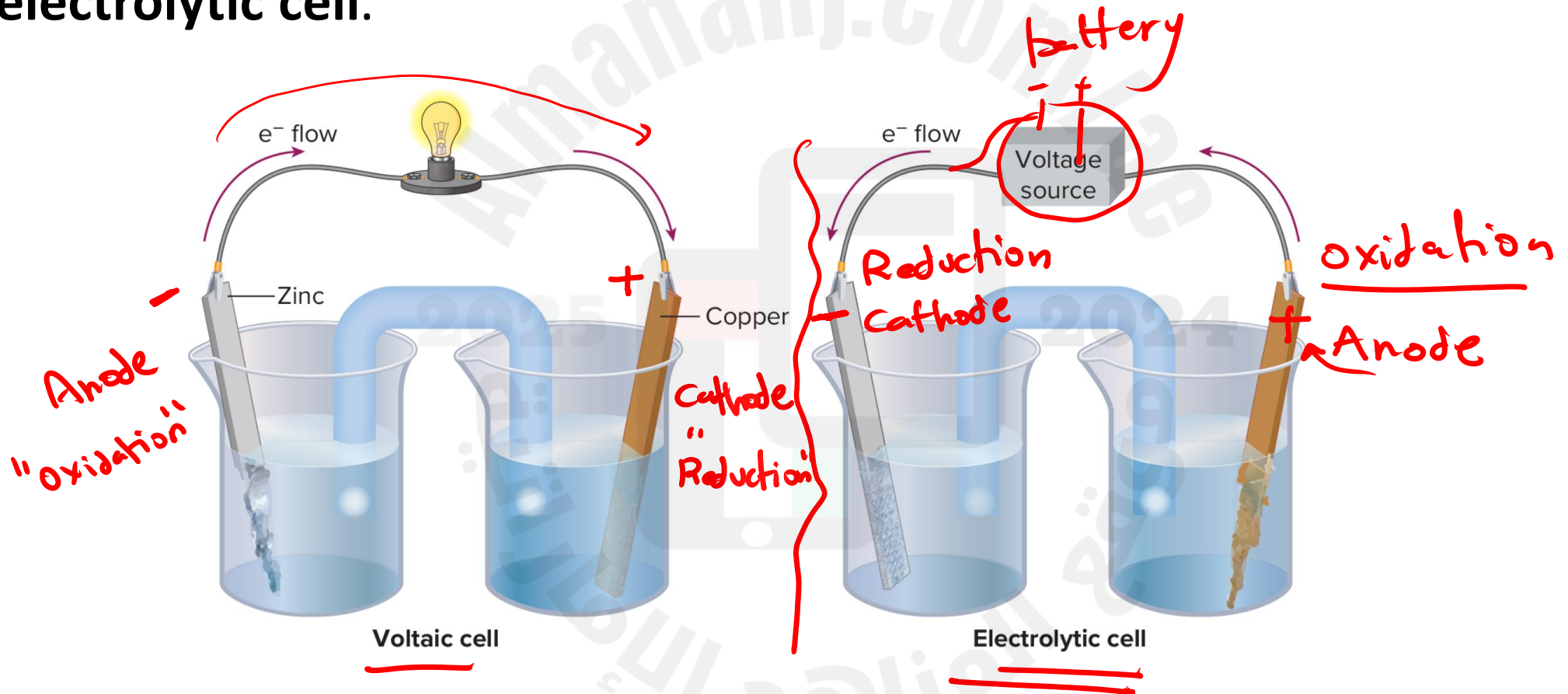
Lesson 1
Voltric cells

- Reversing Redox Reaction

- The use of electrical energy to ^{cause} bring about a chemical reaction is called **electrolysis**.
- An electrochemical cell in which ^{happens} electrolysis occurs is called an **electrolytic cell**.
- For example, when a secondary battery is recharged, it is acting as an electrolytic cell.

Reversing Redox Reactions

- The use of electrical energy to bring about a chemical reaction is called **electrolysis**.
- An electrochemical cell in which electrolysis occurs is called an **electrolytic cell**.



Quiz

1. Which is the use of electrical energy to bring about a chemical reaction?

- 1 reduction
- 2 galvanization
- 3 electrolysis **CORRECT**
- 4 oxidation

Quiz

2. Which is an electrochemical cell in which electrolysis occurs?

A a voltaic cell

C a half-cell

B a fuel cell

D an electrolytic cell

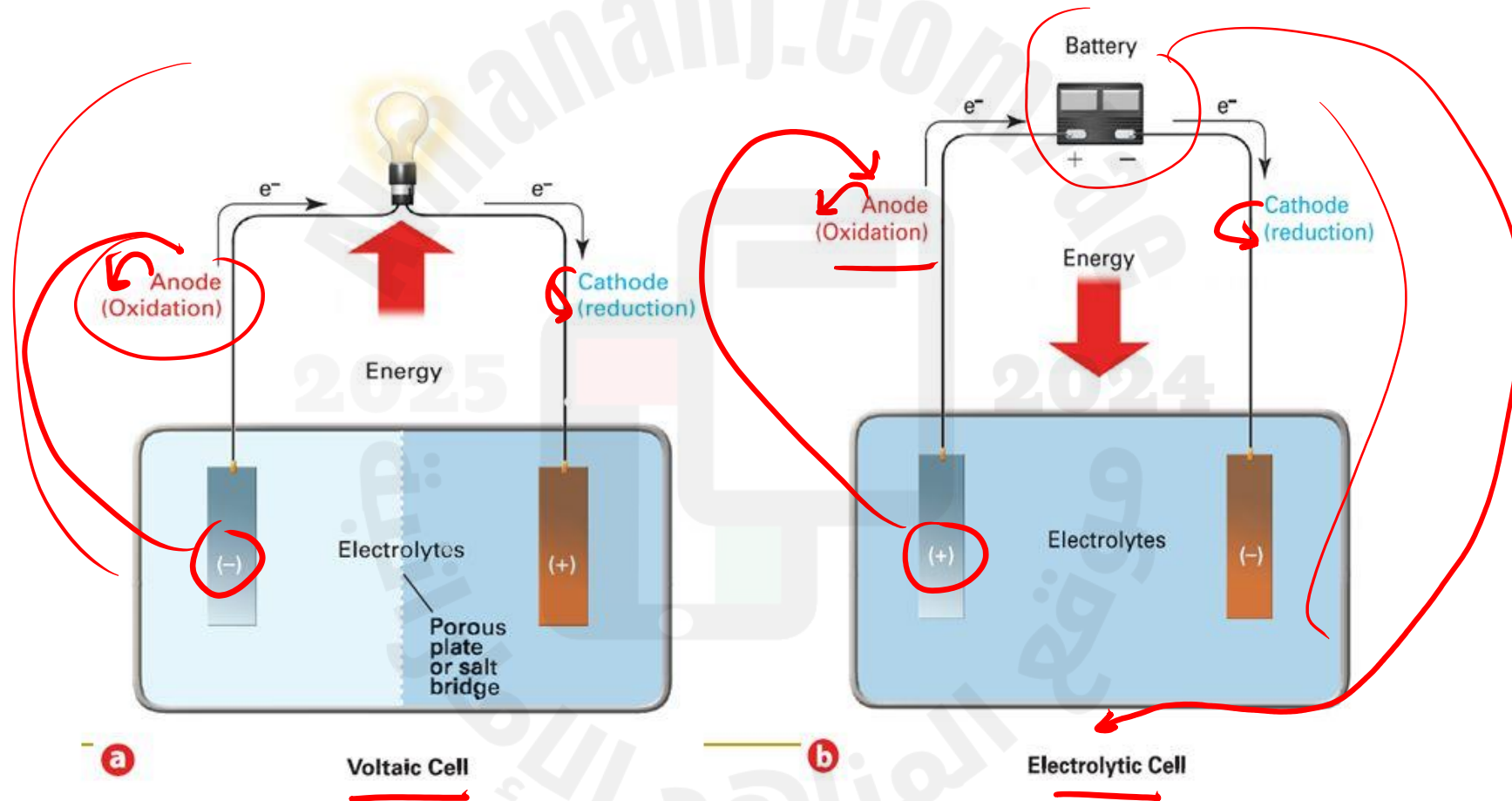
CORRECT

Differences between voltaic cells and electrolytic cells

Lesson 1

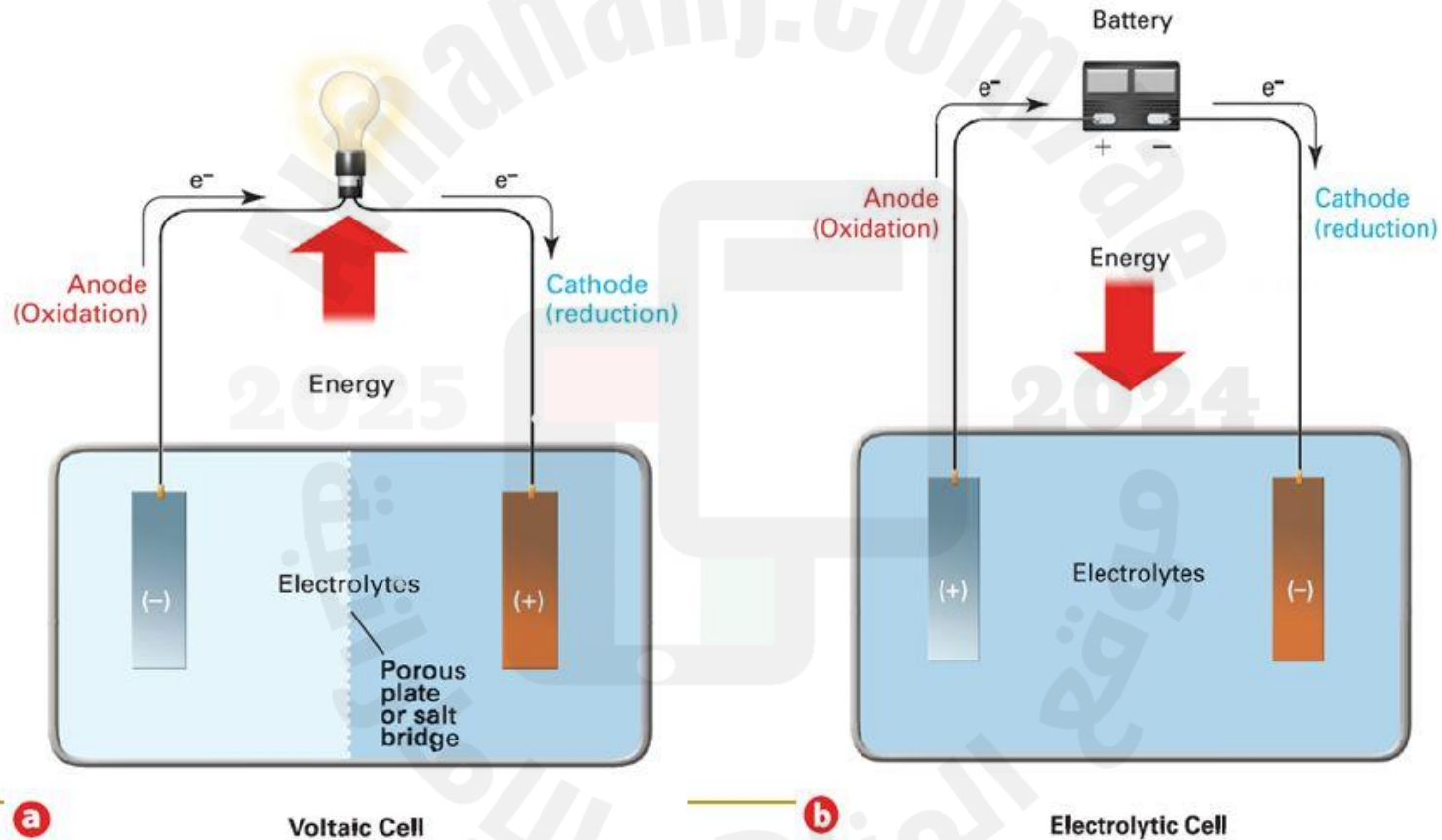
Lesson 3

Voltaic Cells -vs- Electrolytic Cells



Differences between voltaic cells and electrolytic cells

Voltaic Cells -vs- Electrolytic Cells



Differences between voltaic cells and electrolytic cells

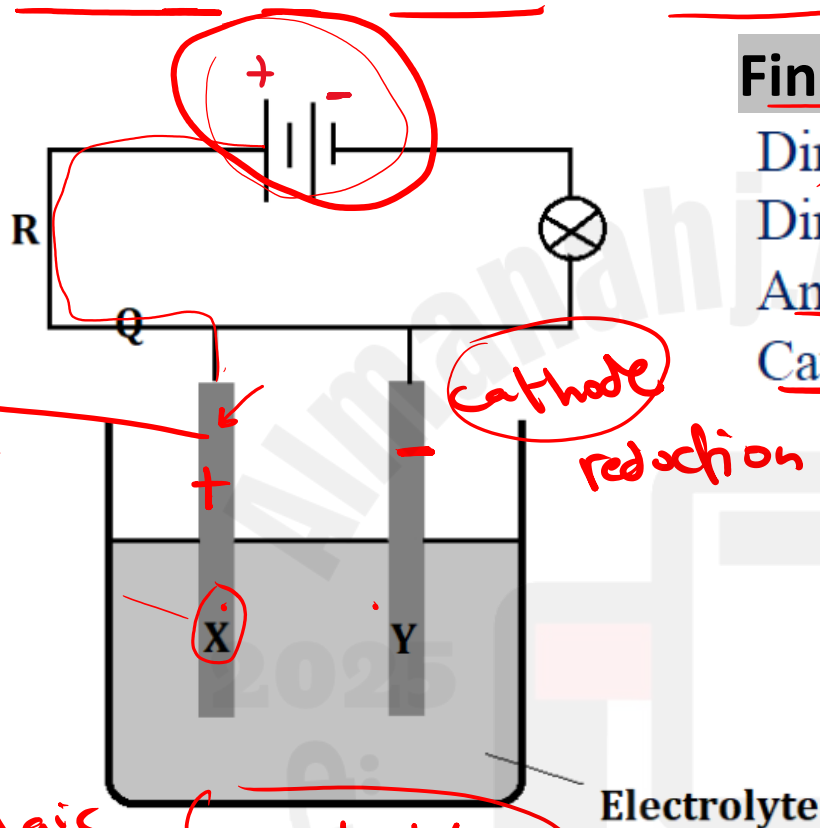
Voltaic Cell	Electrolytic Cell
Chemical energy → Electrical energy	Electrical energy → Chemical energy
Voltaic cells convert chemical energy to electrical energy as a result of a spontaneous redox reaction.	Electrolytic cells use electrical energy to drive a nonspontaneous reaction.
In these electrochemical cells, the anode is negatively charged, and the cathode is positively charged.	These cells feature a positively charged anode and a negatively charged cathode.
The electrons originate from the species that undergoes oxidation.	Electrons originate from an external source (such as a battery).

NOTE: Cathode is ALWAYS where Reduction happens regardless if the cell is voltaic or Electrolytic.

Anode is Always where oxidation happens regardless if the cell is Voltaic or Electrolytic.

Example:

On the diagram below, an electrolyte, MX, was electrolyzed. Show the following:



Find the following:

Direction of flow of electric current in external circuit.

Direction of flow of electrons

Anode

Cathode

- X is "Anode" (+) and Y is "Cathode"(-)
- Electrons move from X to Y.
- Current moves from Y to X.

-What type of electrochemical cells is this?

Electrolytic cell

-Is the reaction spontaneous or non-spontaneous?

non-spontaneous

$E^{\circ}_{cell} < 0$ negative

Activity: concept check

- What type of electrochemical cell is this?

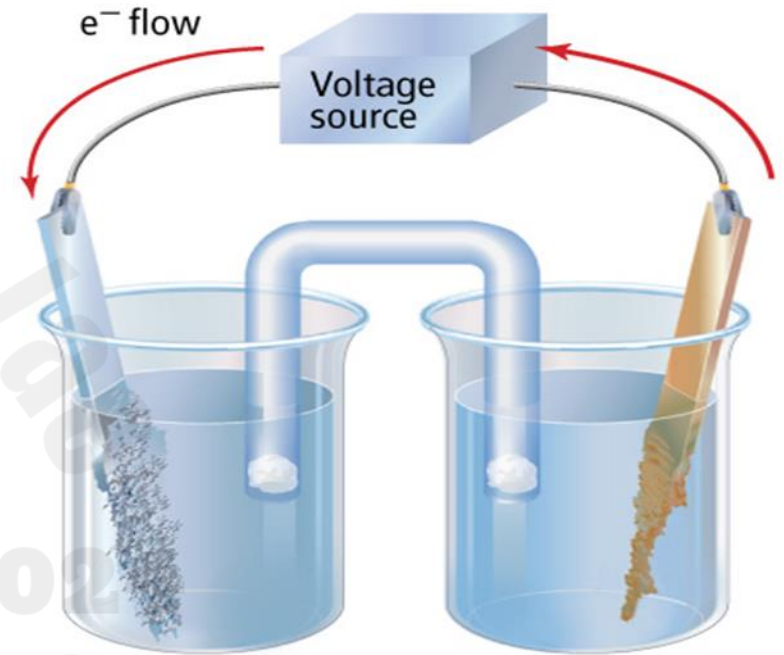
Electrolytic cell

- What is the charge on anode and cathode?

Anode is positive and cathode is negative

- Is the cell reaction spontaneous or nonspontaneous?

Nonspontaneous



Electrolytic cell

Part 2



Learning objectives:

Write half-cell reactions while identifying the products of electrolysis of molten ionic compounds

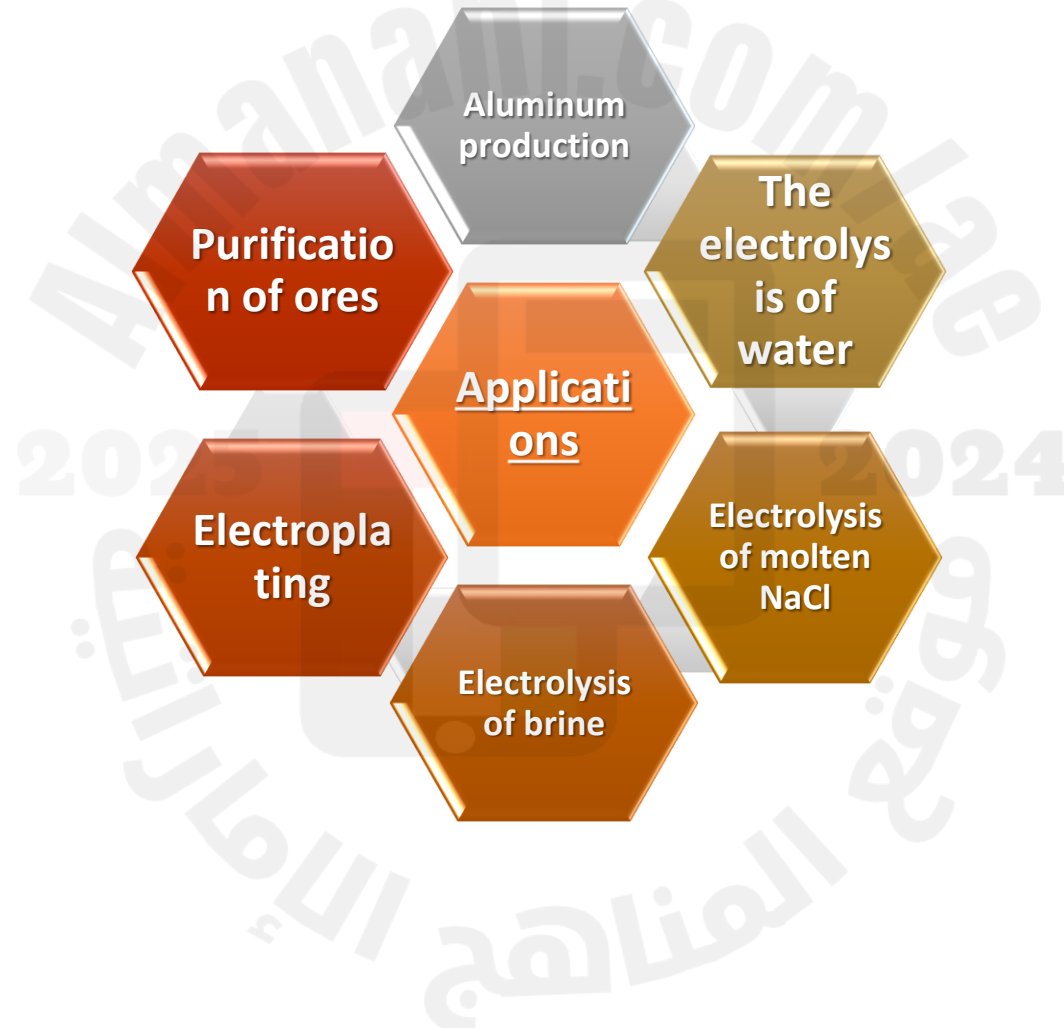
ذائبة (l)
↗

Write half-cell reactions while identifying the products of electrolysis of aqueous ionic compounds

in water (aq)

Define electroplating while **describing how it works**, identifying anode, cathode and electrolyte needed for an electrolytic cell in which a selected metal is to be plated on an object (car or spoon,...etc)

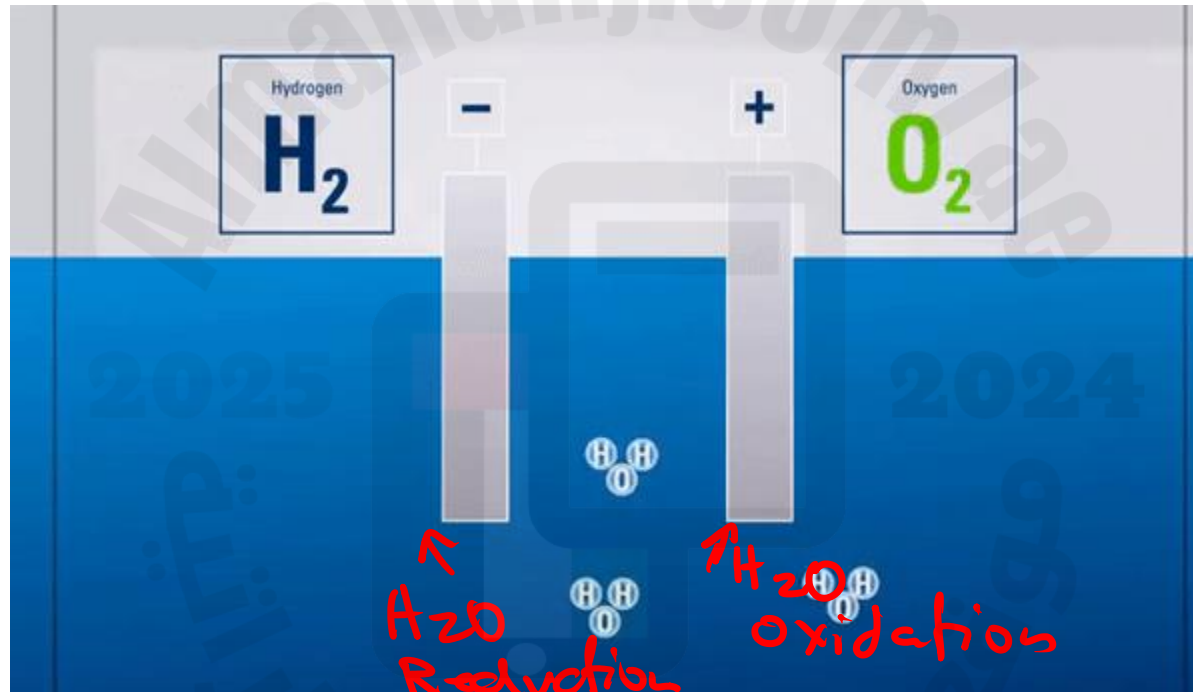
Applications of Electrolysis



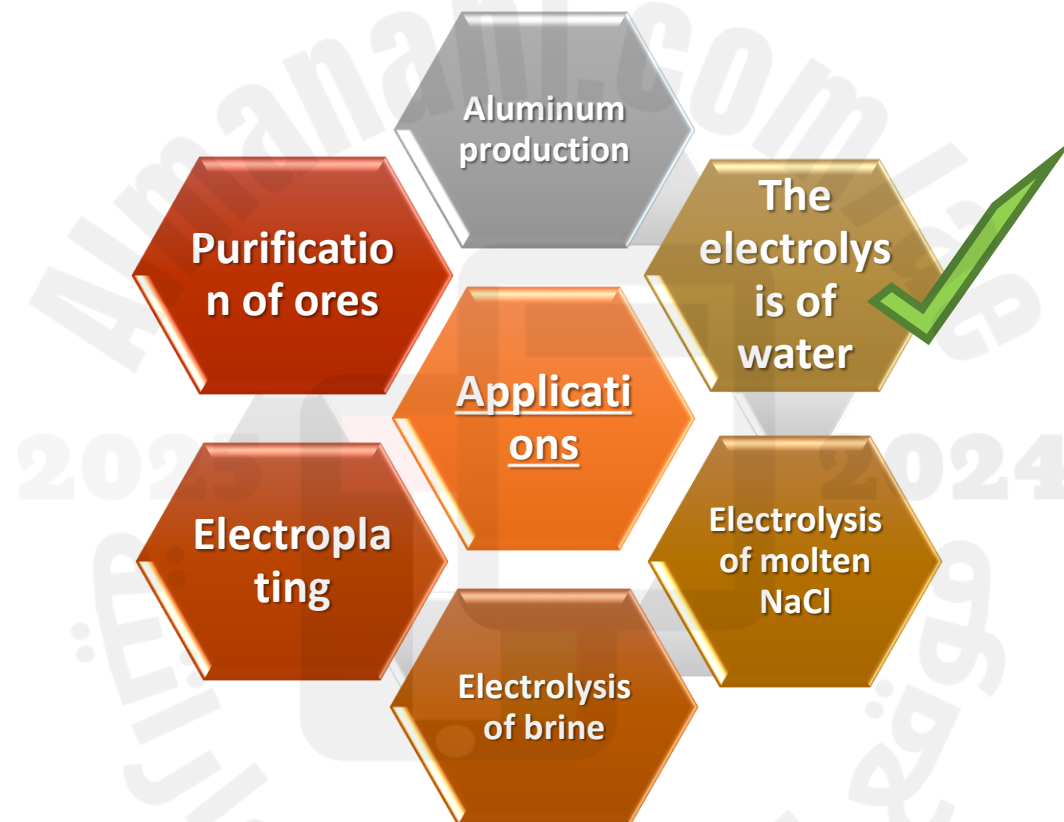
Applications of Electrolysis: The electrolysis of water

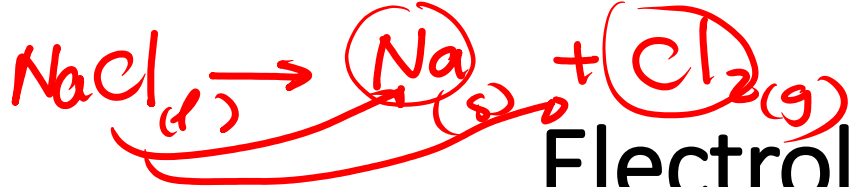
The electrolysis of water is one method by which **hydrogen gas** can be generated for commercial use.

Use electrical energy to drive a nonspontaneous reaction.



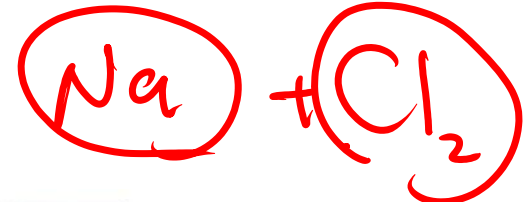
Applications of Electrolysis





Electrolysis of molten NaCl

- Electrolysis can separate molten sodium chloride into sodium metal and chlorine gas in a chamber called a **Down's cell**.



Reactions in Down's Cell

Ionic compounds can conduct electricity only when their ions are free to move, such as when they are dissolved in water or are in the molten state.

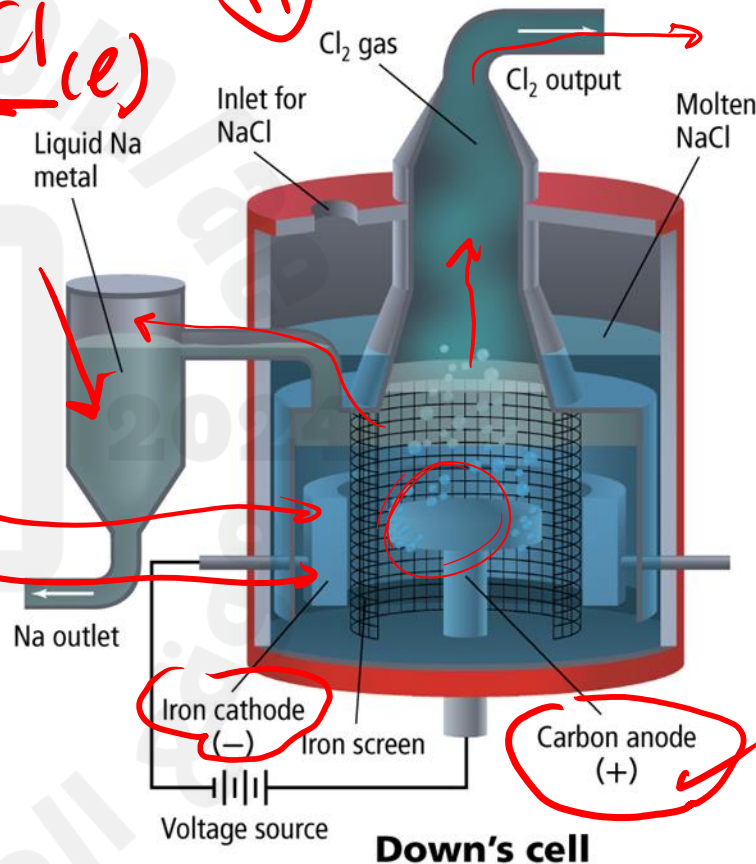
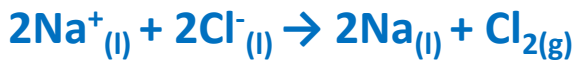
- At the **anode**, chloride ions are oxidized to chlorine (Cl_2) gas.



- At the **cathode**, sodium ions are reduced to sodium metal.



- The net cell reaction;**

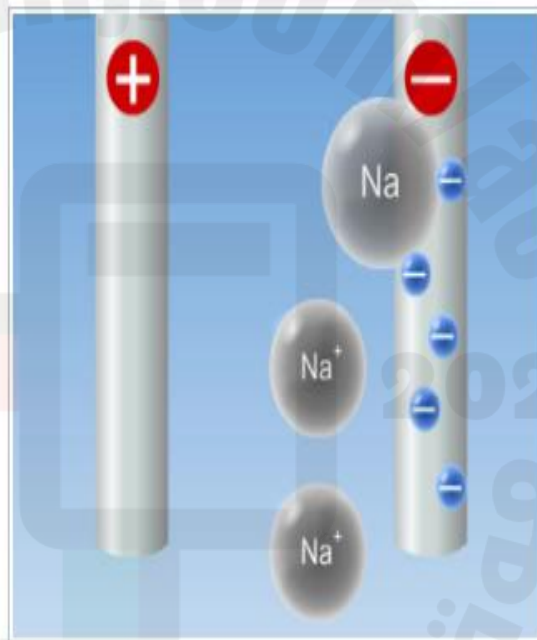


Down's cell

Electrolysis of molten NaCl

Electrolysis of Molten Sodium Chloride:
the Cathode

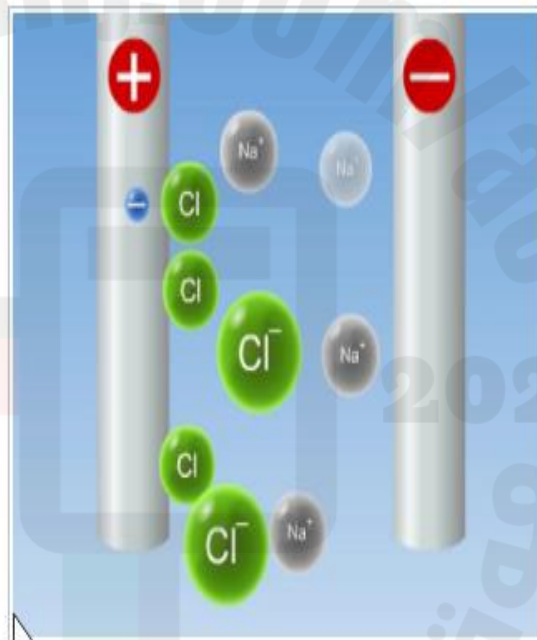
The reduction reaction occurring at the cathode is a half-reaction that involves the exchange of electrons.



Electrolysis of molten NaCl

Electrolysis of Molten Sodium Chloride:
the Anode

When a chloride anion comes into contact with the surface of the anode, it transfers an electron onto the anode, thus becoming an electrically neutral chlorine atom.



Electrolysis of molten NaCl

- Electrolysis can separate molten sodium chloride into sodium metal and chlorine gas in a chamber called a **Down's cell**.



- Importance of sodium:** sodium is used as a catalyst in the synthesis of organic compounds, in nuclear reactors, sodium is used in water purification, sodium lamps used for outdoor lighting, chlorine compounds are used as a variety of ionic compounds or as bleach. sodium are present in the food. Chlorine is used in the production of paper, plastics, insecticides, textiles, dyes, and paints.
- Importance of Chlorine:**



Electrolysis of molten NaCl

- Electrolysis can separate molten sodium chloride into sodium metal and chlorine gas in a chamber called a **Down's cell**.

- **Importance of sodium:**

sodium is used as a coolant in nuclear reactors, sodium vapor lamps used for outdoor lighting,

- **Importance of Chlorine:**

used in water purification, chlorine compounds are used as bleach. Chlorine is used in the production of paper, plastics, insecticides, textiles, dyes, and paints.

Activity

- Should the potential be positive or negative?

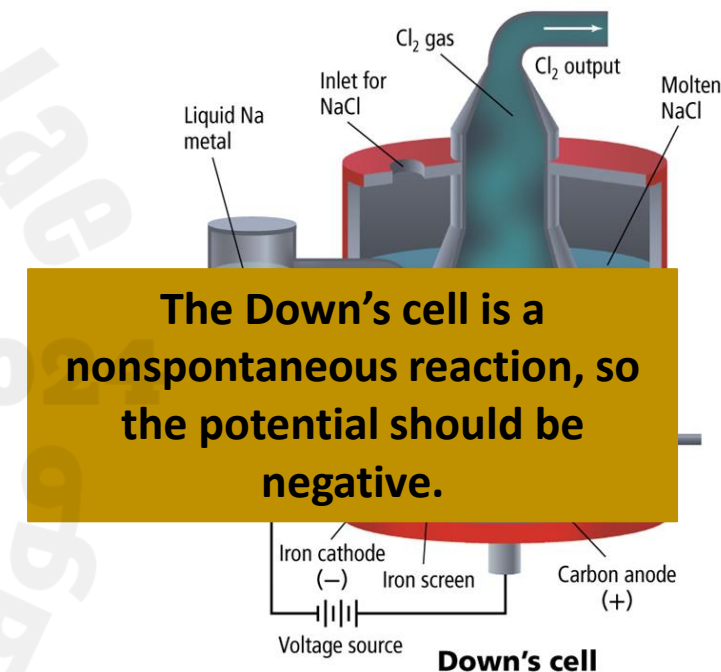
At the anode: *Oxidation*



At the cathode: *Reduction*



Overall cell reaction:



The Down's cell is a nonspontaneous reaction, so the potential should be negative.

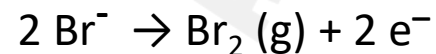
non spontaneous (electrolytic cell)

Activity

The electrolysis of molten lead (II) bromide, PbBr_2

Ions are: Pb^{2+} and Br^-

At the anode:

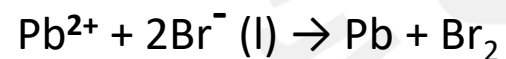


REMEMBER: Molten = Liquid (l)

At the cathode:



Overall cell reaction:



We produced solid "Pb" and gaseous "Br₂"

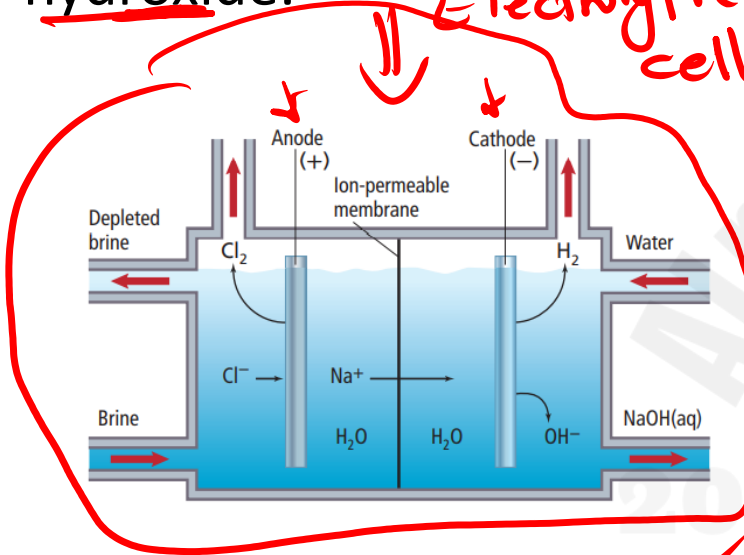
Electrolysis of brine (Aqueous Solution)



Brine is an aqueous solution of sodium chloride. Brine can be decomposed by electrolysis to produce hydrogen, chlorine and sodium hydroxide.



Electrolytic cell



Cell reactions

Reduction

At the cathode: two reactions are possible;



reduction

Water is easier to reduce, and thus is reduced preferentially.

At the anode: two reactions are possible;



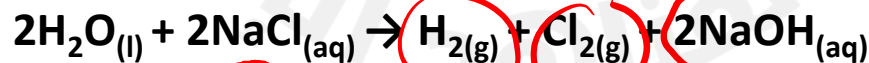
oxidation



Because chlorine is the desired product the concentration of chloride ions is kept high in order to favor this half-reaction.

very important

The overall cell reaction;



Quiz

4. In the decomposition of brine, electrolysis is used to produce _____.

A $\text{H}_2(\text{g})$, $\text{Cl}_2(\text{g})$ and $\text{NaOH}(\text{aq})$ **CORRECT**

X $\text{H}_2(\text{g})$, $\text{Cl}_2(\text{g})$, $\text{O}_2(\text{g})$ and $\text{Na}(\text{s})$

X $\text{H}_2\text{O}(\text{l})$ and $\text{NaCl}(\text{aq})$

X $\text{H}_2\text{O}(\text{l})$ and $\text{NaCl}(\text{s})$

Electroplating

- **Electroplating** is the process of applying a **uniform coating** of metal on another piece of metal usually as a **protective** or **decorative** layer.

GOLD PLATED
WATCH



COPPER PLATED
MUG



SILVER PLATED
TEAPOT



SILVER PLATED
GOBLET



CHROME
ELECTROPLATED
TAP

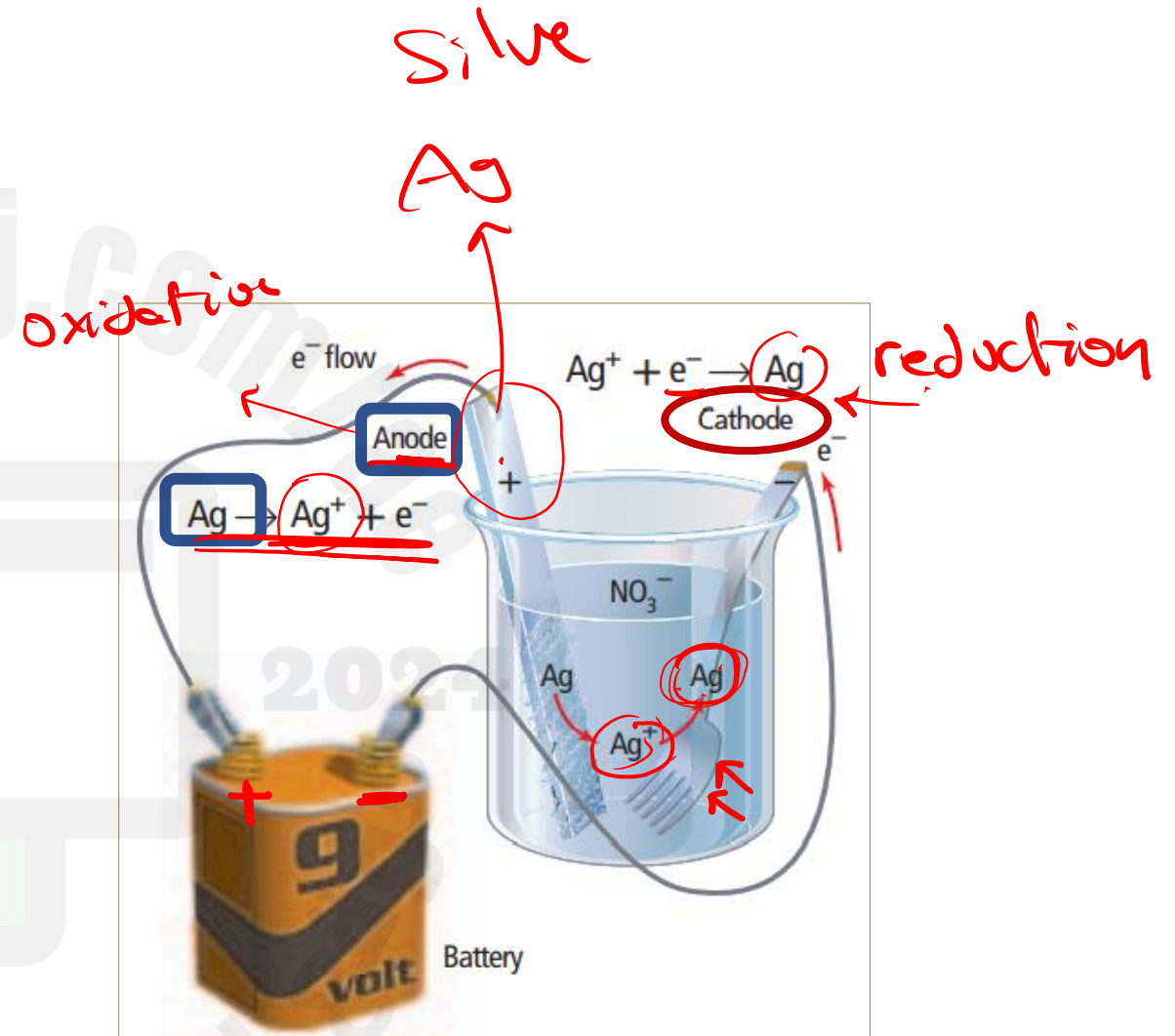


Electroplating

- **Electroplating** with a metal such as silver is accomplished with a method similar to that used to refine copper.

Silver plating

In silver plating the object to be plated is the cathode where silver ions in the electrolyte solution are reduced to silver metal and deposited on the object.

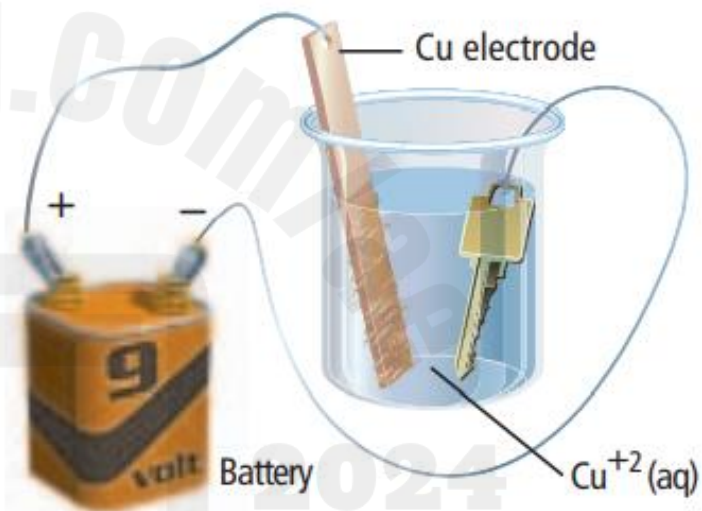


Activity

Figure shows a key being **electroplated with copper (Cu)** in an electrolytic cell.

Where does oxidation occur?

Explain your answer.



Oxidation happens in the Cu electrode because it is the Anode (+)

Reduction happens in the Key because it is the cathode (-), also because the Cu will be plated on the key, which makes it the cathode automatically.

Quiz

5. Which occurs where an object is being electroplated?

oxidation

corrosion

reduction **CORRECT**

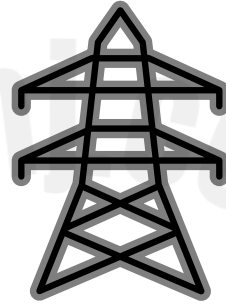
galvanization

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Section summary



- In an electrolytic cell, an outside source of power causes a nonspontaneous redox reaction to occur.
- The electrolysis of molten sodium chloride yields sodium metal and chlorine gas.
- The electrolysis of brine yields hydrogen gas, sodium hydroxide, and chlorine gas.
- Metals such as copper are purified in an electrolytic cell.
- Electrolysis is used to electroplate objects and to produce pure aluminum from its ore.