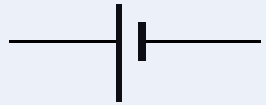
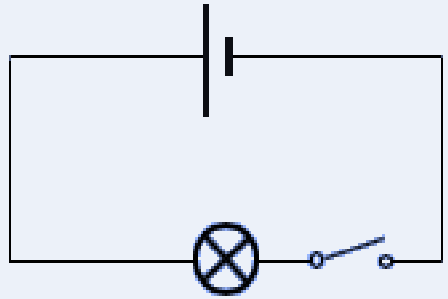
Introduction to Electrolysis

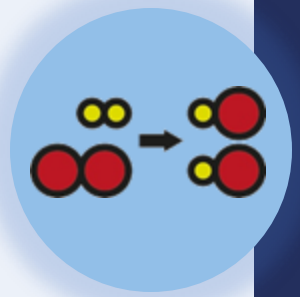
Answer the questions below.

1. State the equation to calculate power in a circuit.
   Power = current x potential different (P = IV)
2. State the equation used to calculate energy transferred in a circuit.
   energy transferred = current x time x potential difference
3. Write down the ions that are present in potassium oxide.
   K^+ and O^{2-}
4. Draw the symbol for a cell in an electric circuit.



5. Draw a simple circuit diagram, which contains a cell, a bulb, and a switch connected in series.





Do Now

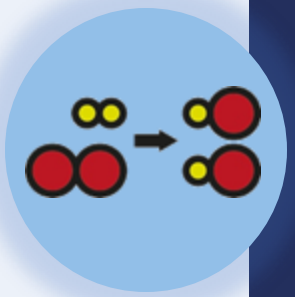
Introduction to Electrolysis

Do Now:

1. State the equation to calculate power in a circuit.
2. State the equation used to calculate energy transferred in a circuit.
3. Write down the ions that are present in potassium oxide.
4. Draw the symbol for a cell in an electric circuit.
5. Draw a simple circuit diagram, which contains a cell, a bulb, and a switch connected in series.

Drill:

1. Write a word equation for the reaction where hydrogen gas and oxygen gas react to form water.
2. Write a balanced chemical equation for the reaction where hydrogen gas and oxygen gas react to form water.



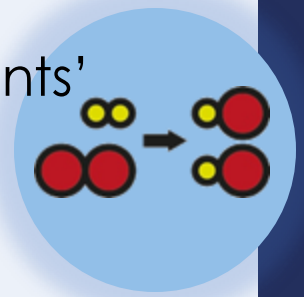
Do Now

Introduction to Electrolysis

Read Now:

A Chinese research team has developed a new processing method to transform seawater into sustainable hydrogen fuel. Seawater is the ideal candidate to be **utilised** as hydrogen fuel, as it is renewable, extremely **abundant**, **economical**, and has the right ingredients to produce high quality hydrogen. Electrolysis involves applying an electric current to water to split it up into it's constituents, producing hydrogen and oxygen. The resulting hydrogen can be used as clean hydrogen fuel that only emits water when burned, in contrast to fossil fuels that pump out harmful carbon emissions.

1. What has the Chinese research team developed?
2. Why is seawater a good substance from which to make fuel?
3. Define the terms in **bold**.
4. Read the underlined sentence again. What do you think the word 'constituents' means?
5. What advantage does hydrogen have as a fuel over fossil fuels?



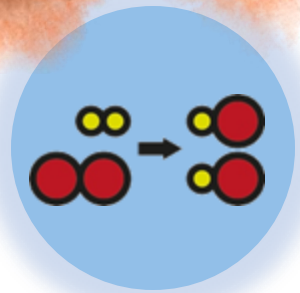
Do Now

03/02/2025

Introduction to Electrolysis

C4.2.7

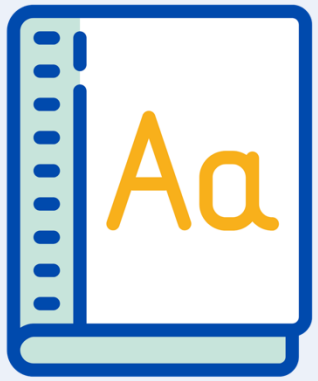
Science Mastery



Following this lesson, students will be able to:

- Define electrolysis
- List the ions present in an electrolyte, and predict their movement when the current is switched on in electrolysis
- Explain why electrolysis cannot be carried out with a solid ionic substance

Key Words:



anode **cathode** **discharged**

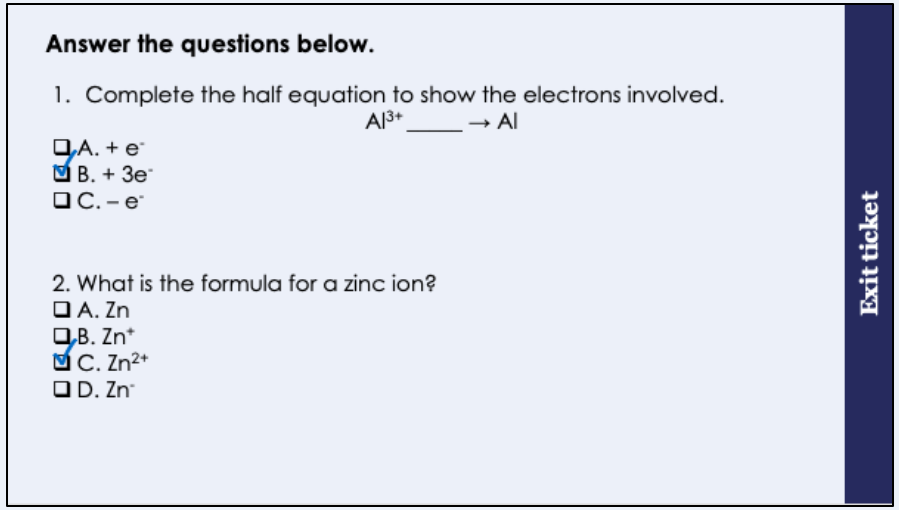
electrolysis **electrolyte**

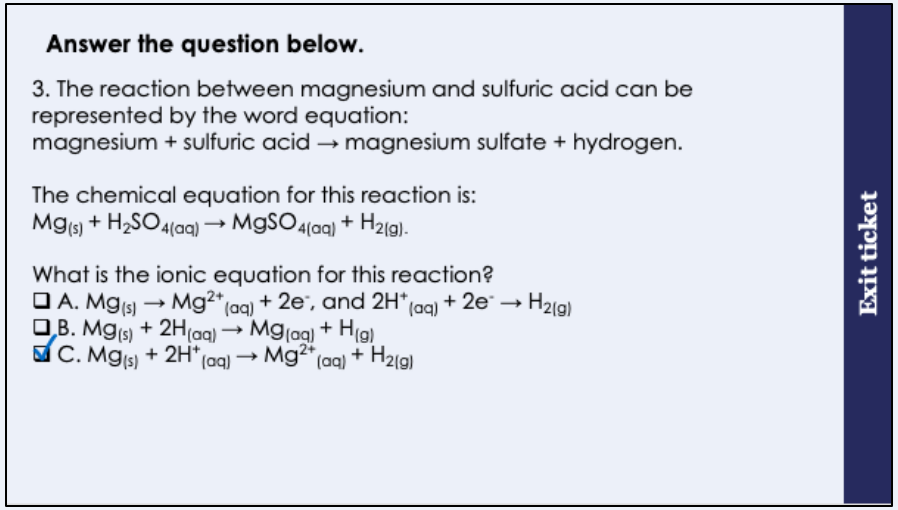
Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.





Fix-it

Word: Electro**lysis**

Comes from:

Electro- — *'Electricity'*

-lysis — *'splitting'*

Example:
Lithium chloride (LiCl)

will split up into
Li^+ and **Cl^-** ions

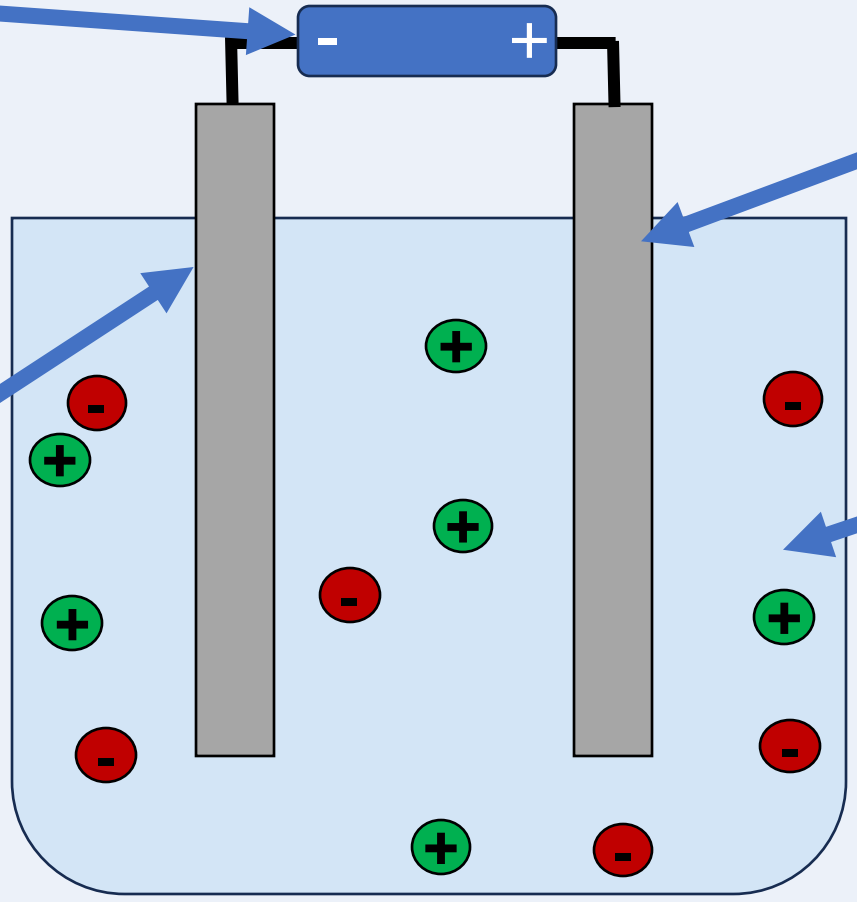
Definition: **Electrolysis** is the process of passing an electric current through a substance, to split it up into its ions.

Can you list the ions in each substance?

Electrolyte	Positive ion (cation)	Negative ion (anion)
Sodium chloride	Na^+	Cl^-
Aluminium oxide	Al^{3+}	O^{2-}
Copper (II) nitrate	Cu^{2+}	NO_3^-

What happens in electrolysis?

Battery or power source
Generates a current to flow through the electrolyte



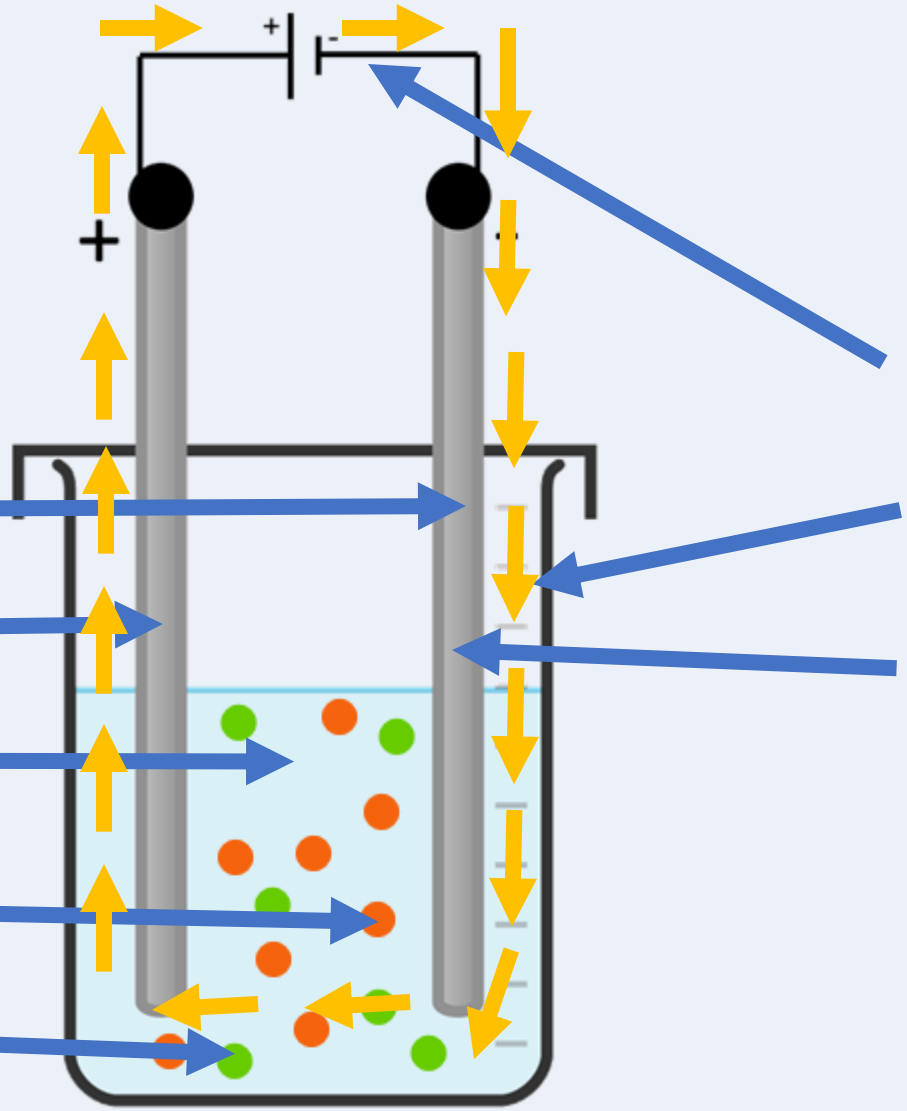
Cathode
Negatively charged electrode

Anode
Positively charged electrode

Electrolyte
The liquid that contains the ions (current is passed through)

Can you correctly label the electrolysis diagram?

- = positively charged ions
- = negatively charged ions



cell/battery

cathode

beaker

anode

an inert material

electrolyte

cation

Stretch: the flow of electrons when the circuit is switched on

anion

Writing half equations at each electrode

Higher Tier only

At the anode (+)

- anions (negative ions) are discharged
- they **lose** electrons
- they are **oxidised**

$2F^- \rightarrow F_2 + 2e^-$

$2Cl^- \rightarrow Cl_2 + 2e^-$

$2O^{2-} \rightarrow O_2 + 4e^-$

At the cathode (-)

- cations (positive ions) are discharged
- they **gain** electrons
- they are **reduced**

$Na^+ + e^- \rightarrow Na$

$Li^+ + e^- \rightarrow Li$

$Mg^{2+} + 2e^- \rightarrow Mg$

Consider the electrolysis of molten sodium chloride.

With your partner, see how many points you can make that fit into the two categories below:

What I would **observe**	What is happening that I **could not observe**

Talk Task

Drill

1. Define electrolysis.
2. What is an electrolyte?
3. What is the positive electrode called?
4. What is the negative electrode called?
5. Why does an electrolyte have to be a liquid?
6. What electrode does a cation move towards?
7. What electrode does an anion move towards?
8. At which electrode does oxidation take place?
9. At which electrode does reduction take place?
10. *(HT only) Write a half equation to show what happens when chloride ions are discharged at the anode.*

Check for understanding

Drill answers

1. Electrolysis is the process of passing an electric current through a substance, to break it down into its ions.
2. An electrolyte is a liquid that contains ions.
3. The positive electrode is called the anode
4. The negative electrode is called the cathode
5. An electrolyte has to be a liquid so that the ions are free to move.
6. A cation (+) moves towards the cathode (-)
7. An anion (-) moves towards the anode (+)
8. Oxidation takes place at the anode
9. Reduction takes places at the cathode
10. $2Cl^- \rightarrow Cl_2 + 2e^-$

Check for understanding

I: Describing what happens in electrolysis

A scientist carried out the electrolysis of sodium chloride.

Describe what will happen when the current is switched on.

- When electrolysis occurs, **sodium chloride is split up into its ions**.
- The positive ion (cation) is **Na^+**.
- Because this ion is positively charged, it will be **attracted to the negative electrode** (cathode).
- Here, the positive ion will be **reduced** (gains electrons).
- *(HT only) The half equation for this is* **$Na^+ + e^- \rightarrow Na$**
- The negative ion (anion) is **Cl^-**.
- Because this ion is negatively charged, it will be **attracted to the positive electrode** (anode).
- Here, the negative ion will be **oxidised** (loses electrons)
- *(HT only) The half equation for this is* **$2Cl^- \rightarrow Cl_2 + 2e^-$**

Apply

We: Describing what happens in electrolysis

A scientist carried out the electrolysis of lithium chloride.

Describe what will happen when the current is switched on.

- When electrolysis occurs, **lithium chloride is split up into its ions**.
- The positive ion (cation) is **Li^+**.
- Because this ion is positively charged, it will be **attracted to the negative electrode** (cathode).
- Here, the positive ion will be **reduced** (gains electrons).
- *(HT only) The half equation for this is* ***$Li^+ + e^- \rightarrow Li$***
- The negative ion (anion) is **Cl^-**.
- Because this ion is negatively charged, it will be **attracted to the positive electrode** (anode).
- Here, the negative ion will be **oxidised** (loses electrons)
- *(HT only) The half equation for this is* ***$2Cl^- \rightarrow Cl_2 + 2e^-$***

Apply

You: Describing what happens in electrolysis

A scientist carried out the electrolysis of magnesium oxide.

Describe what will happen when the current is switched on.

- When electrolysis occurs, **magnesium oxide is split up into its ions**.
- The positive ion (cation) is **Mg^{2+}**.
- Because this ion is positively charged, it will be **attracted to the negative electrode** (cathode).
- Here, the positive ion will be **reduced** (gains electrons).
- *(HT only) The half equation for this is* **$Mg^{2+} + 2e^- \rightarrow Mg$**
- The negative ion (anion) is **O^{2-}**.
- Because this ion is negatively charged, it will be **attracted to the positive electrode** (anode).
- Here, the negative ion will be **oxidised** (loses electrons)
- *(HT only) The half equation for this is* **$2O^{2-} \rightarrow O_2 + 4e^-$**

Apply

Answer the questions below.

1. Which answer correctly describes the 'anode'?

- ❑ A. a positive ion
- ❑ B. a negative ion
- ☑ C. the positive electrode
- ❑ D. the negative electrode

2. Which answer correctly explains why electrolysis will not work with solid sodium chloride?

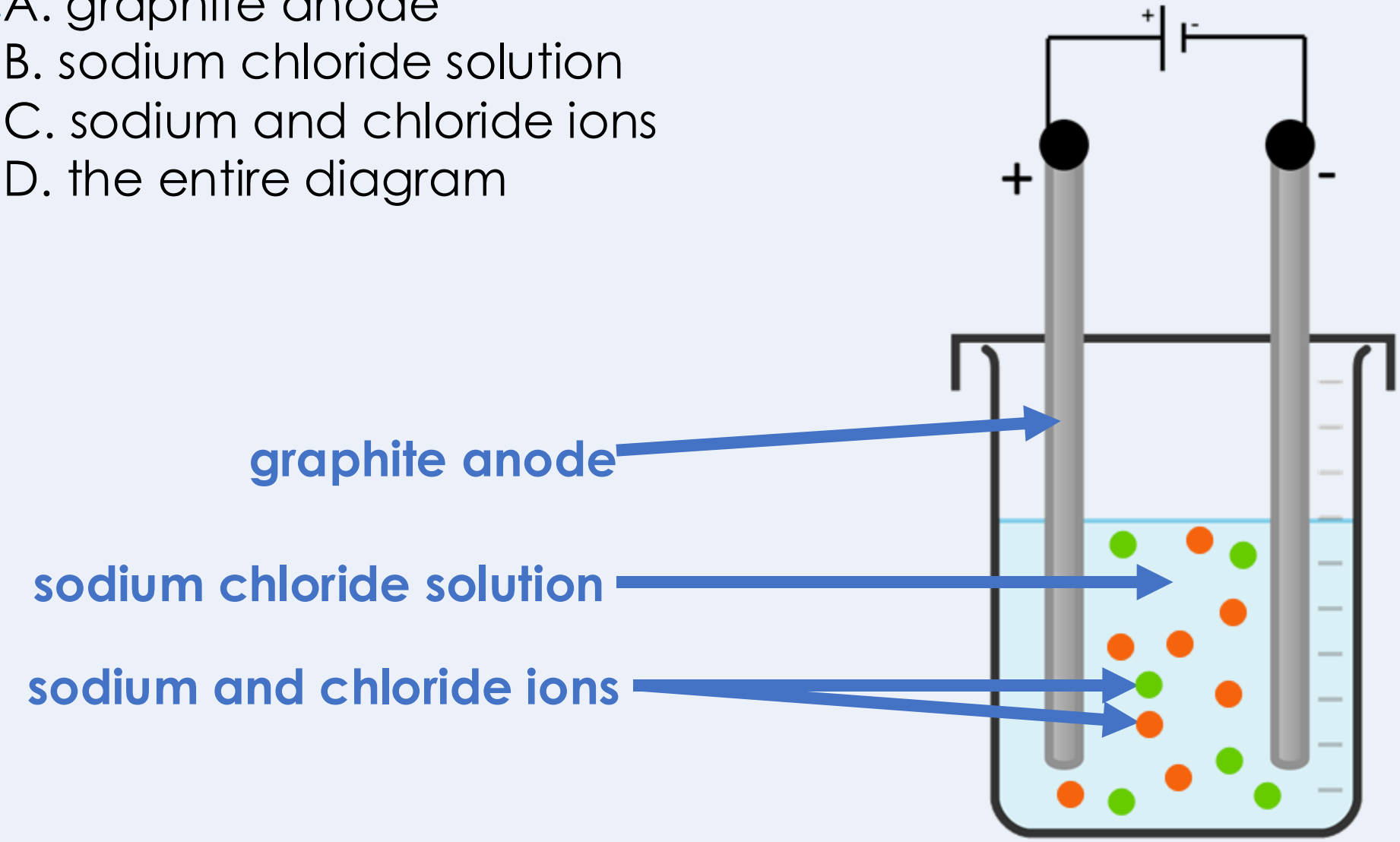
- ☑ A. Solid sodium chloride doesn't conduct electricity because the ions cannot move in a solid
- ❑ B. Solid sodium chloride doesn't conduct electricity because the particles cannot move in a solid
- ❑ C. Solid sodium chloride doesn't conduct electricity because the electrons cannot move in a solid
- ❑ D. Electrolysis will work with solid sodium chloride

Exit ticket

Answer the question below.

3. Which answer below describes the **electrolyte**?

- ☐ A. graphite anode
- ☑ B. sodium chloride solution
- ☐ C. sodium and chloride ions
- ☐ D. the entire diagram



Exit ticket

Feedback

Lesson C4.2.7	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!