

The process of electrolysis

4.4.3.1 · Chemical changes · revision notes

What electrolysis is, why an ionic compound must be molten or dissolved to be electrolysed, and which way the ions move. This is the basis of every other electrolysis subtopic and often opens a longer question.

Key facts

- Electrolyte = molten or dissolved ionic compound; its ions are free to move
- Positive ions → cathode; negative ions → anode
- Discharged = an ion becomes an element at an electrode
- Cathode = negative electrode; anode = positive electrode
- PANIC: Positive is Anode, Negative Is Cathode
- Inert electrodes (graphite, platinum) do not react

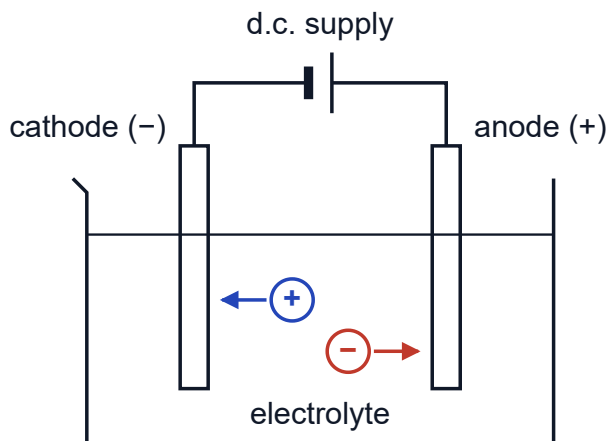
Notes

Electrolytes

- Ionic compounds conduct electricity when **melted** (molten) or **dissolved in water**, because the ions are then **free to move**.
- Solid ionic compounds do not conduct: the ions are held in fixed positions in the lattice and cannot move.
- A molten or dissolved ionic compound that conducts electricity is called an **electrolyte**.
- Electrolysis** is breaking down an electrolyte into elements using electricity (a direct current).

Movement of ions

- Two **electrodes** dip into the electrolyte and are connected to a d.c. power supply.
- The **cathode** is the **negative** electrode. **Positive** ions, such as metal ions and H^+ , are attracted to it.
- The **anode** is the **positive** electrode. **Negative** ions, such as Cl^- , Br^- and O^{2-} , are attracted to it.
- Opposite charges attract, so each ion moves towards the electrode with the opposite charge.



positive ions $\rightarrow$ cathode; negative ions $\rightarrow$ anode

Opposite charges attract. The short thick line of the cell symbol is the negative terminal.

Discharge at the electrodes

- At the electrodes the ions are **discharged** and form elements.
- At the cathode, a metal (or hydrogen) is produced.
- At the anode, a non-metal such as a halogen or oxygen is produced.
- Inert electrodes**, e.g. graphite or platinum, are used so that the electrodes do not react with the electrolyte or the products.

How to answer each type of question

Define key terms

1 mark each

Grade 4

- Learn short, exact definitions of electrolyte, electrolysis, cathode and anode.
- Include the charge when you name an electrode.

Example. (a) What is an electrolyte?
(b) What is the name of the positive electrode?

Model answer. (a) A molten or dissolved ionic compound / a liquid or solution that conducts electricity
(1)
(b) Anode (1)

Predict which electrode ions move to, and why

2 marks

Grade 5

1. Positive ions go to the cathode (negative); negative ions go to the anode (positive).
2. Explain using attraction between opposite charges.

Example. Molten zinc chloride, ZnCl_2 , is electrolysed.

- (a) Which ions move to the cathode?
- (b) Explain why.

Model answer. (a) Zinc ions / Zn^{2+} (1)

(b) They are positive, so they are attracted to the negative electrode (1)

Don't lose marks

- ✗ Saying electrons move through the electrolyte: in the electrolyte it is the ions that move.
- ✗ Mixing up which electrode is positive and which is negative.
- ✗ Saying solid ionic compounds do not conduct because they have no ions: they have ions, but the ions cannot move.
- ✗ Writing 'molecules' or 'atoms' when you mean ions.

More tips

Memory tricks

- PANIC: Positive Anode, Negative Is Cathode.
- Cations go to the cathode and anions go to the anode (match the first letters: cat-cat, an-an).
- Opposites attract: positive ions to the negative electrode, negative ions to the positive electrode.

Exam technique

- In conduction questions, the phrase 'ions are free to move' earns the key mark.
- Name an electrode and give its charge: 'the cathode (negative electrode)'.
- If you draw the apparatus, label the d.c. supply, both electrodes (cathode and anode) and the electrolyte.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Name the electrodes and their charges

The cathode is the negative electrode and the anode is the positive electrode.

Grade 4

Define an electrolyte

A molten or dissolved ionic compound, which conducts electricity because its ions are free to move.

Grade 5

Predict which electrode each ion moves to

Positive ions move to the cathode and negative ions move to the anode.