

CAIE Chemistry IGCSE

4.1 Electrolysis

Flashcards

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What does the term electrolysis mean?



What does the term electrolysis mean?

The breakdown of a molten or aqueous ionic compound using electricity (an electric current being passed through).



What is the cathode and anode?



What is the cathode and anode?

Cathode - negatively charged electrode

Anode - positively charged electrode



What is an electrolyte?



What an electrolyte?

- The electrolyte is an ionic compound in the molten or aqueous state that undergoes electrolysis
- Ions in the electrolyte are able to move freely and are attracted towards the electrode with an opposite charge



What is formed at each electrode in electrolysis?



What is formed at each electrode in electrolysis?

Positive electrode: Non metal

Negative electrode: Metal or hydrogen



How can you predict whether a metal or hydrogen will form at the negative electrode during electrolysis of an aqueous compound?



How can you predict whether a metal or hydrogen will form at the negative electrode during electrolysis of an aqueous compound?

- If the metal is less reactive than hydrogen in the reactivity series then the metal will form.
- If the metal is more reactive than hydrogen then hydrogen will form.



What forms at each electrode during the electrolysis of molten lead(II) bromide?



What forms at each electrode during the electrolysis of molten lead(II) bromide?

Anode: Bromine

Cathode: Lead



What forms at each electrode during the electrolysis of concentrated hydrochloric acid?



What forms at each electrode during the electrolysis of concentrated hydrochloric acid?

Anode: Chlorine

Cathode: Hydrogen



What forms at each electrode during the electrolysis of concentrated sodium chloride solution NaCl (aq) ?



What forms at each electrode during the electrolysis of concentrated sodium chloride solution NaCl (aq) ?

Anode: Chlorine (halide ion will form its halogen)

Cathode: Hydrogen (sodium is more reactive than hydrogen)



What forms at each electrode during the electrolysis of dilute sulfuric acid H_2SO_4 (aq)?



What forms at each electrode during the electrolysis of dilute sulfuric acid H_2SO_4 (aq)?

Anode: Oxygen

Cathode: Hydrogen



How can the products of electrolysis of molten electrolytes be predicted?



How can the products of electrolysis of molten electrolytes be predicted?

Anode: non-metal element

Cathode: metal element



Predict what forms at each electrode during the electrolysis of molten zinc chloride



Predict what forms at each electrode during the electrolysis of molten zinc chloride

Anode: Chlorine

Cathode: Zinc



Predict the products of electrolysis of concentrated potassium bromide solution



Predict the products of electrolysis of concentrated potassium bromide solution

Positive electrode: Bromine

Negative electrode: Hydrogen



Predict the products of electrolysis of concentrated copper iodide solution



Predict the products of electrolysis of concentrated copper iodide solution

Positive electrode: Iodine

Negative electrode: Copper



Predict the products of electrolysis of dilute zinc chloride solution



Predict the products of electrolysis of dilute zinc chloride solution

Positive electrode: Oxygen

Negative electrode: Zinc



What is electroplating?



What is electroplating?

A process in which a metal is coated with a layer of another metal.



What are two reasons for using electroplating?



What are two reasons for using electroplating?

- To increase resistance to corrosion.
- To improve appearance (e.g. silver plated cutlery).



Explain how the process of electroplating works



Explain how the process of electroplating works

Similar setup to electrolysis:

The metal being coated is the cathode. The metal that will form the exterior layer is the anode. The electrolyte solution must contain ions of the metal which will form the outer coating. A power supply is connected to both electrodes.



Describe the transfer of charge during
electrolysis (extended only)



Describe the transfer of charge during electrolysis (extended only)

1. The direct current power supply is connected to the cathode, providing electrons, causing it to become negatively charged
2. At the cathode (negatively charged electrode), cations (positively charged ions) from the electrolyte are attracted and gain electrons
3. At the anode (positively charged electrode), anions (negatively charged ions) from the electrolyte are attracted and lose electrons
4. These electrons released at the anode transfer from the anode back to the direct current power supply



Compare the movement of electrons to the movement of ions in electrolysis (extended only)



Compare the movement of electrons to the movement of ions in electrolysis (extended only)

Electrons move through the metallic conductor meaning they move through the wire from the positive electrode to the negative electrode.

Ions move through the electrolyte. Positive ions move to the negative electrode and negative ions move to the positive electrode.



What forms at each electrode during the electrolysis of copper sulfate solution using inert electrodes?
(extended only)



What is formed at each electrode during the electrolysis of copper sulfate solution using inert electrodes? (**extended only**)

Anode: Oxygen (from OH^- ions)

Cathode: Copper (less reactive than hydrogen)



What forms at each electrode during the electrolysis of copper sulfate solution using copper electrodes?
(extended only)



What is formed at each electrode during the electrolysis of copper sulfate solution using copper electrodes? (**extended only**)

Positive electrode: Copper ions (Cu^{2+})

Negative electrode: Copper



Describe the electrolysis of copper (II) sulfate solution using carbon electrodes
(extended only)



Describe the electrolysis of copper (II) sulfate solution using carbon electrodes (extended only)

- Place the inert carbon electrodes into a beaker of copper sulfate solution.
- Connect the electrodes to a power supply.
- Copper ions gain electrons at the cathode to form pure copper. Oxygen ions lose electrons at the anode to form oxygen gas.



How can impure copper be purified using copper sulfate solution and copper electrodes?
(extended only)



How can impure copper be purified using copper sulfate solution and copper electrodes?

(extended only)

Electrolysis:

- The anode is made of impure copper and the cathode is made of pure copper.
- The electrodes are placed in a solution of copper sulfate.
- The copper ions from the impure anode move to the cathode where they gain electrons and form pure copper.
- Impurities form as sludge below the anode.



What is formed at each electrode when
the electrolyte contains a halide
(extended only)



What is formed at each electrode when an aqueous electrolyte contains a halide (**extended only**)

Anode: A halogen will be formed from the halide ion

- Chloride Cl^- ions form chlorine Cl_2
- Bromine Br^- ions form bromine Br_2
- Iodide I^- ions form iodine I_2

Cathode: The metal from the ionic compound



What is oxidation? (extended only)



What is oxidation? (extended only)

Oxidation is the loss of electrons

Oxidation occurs at the anode, where anions will lose electrons to form their elements



What is reduction? (extended only)



What is reduction? (extended only)

Reduction is the gain of electrons

Reduction occurs at the cathode, where cations will gain electrons to form their elements



What does OILRIG stand for?
(extended only)



What does OILRIG stand for? (extended only)

Oxidation

Is

Loss of electrons

Reduction

Is

Gain of electrons



Give the features of half-equations
(extended only)



Give the features of half-equations (extended only)

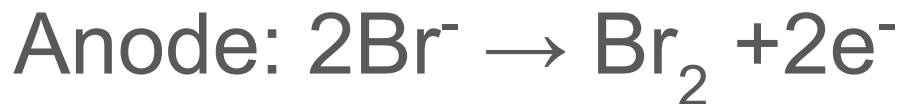
- Half equations show what happens when ions gain or lose electrons:
 - Electrons are written as e^-
 - The overall charge on both sides of the equation must be equal
 - The number of atoms are the same on both sides



Write a half equation to show the
oxidation of bromide ions at the anode
(extended only)



Write a half equation to show the oxidation of bromide ions at the anode (**extended only**)



Write a half equation to show the
reduction of sodium ions at the cathode
(extended only)



Write a half equation to show the reduction of sodium ions at the cathode (**extended only**)



Write half equations for the reactions that occur at the electrodes when molten lead(II) bromide is electrolysed
(extended only)



Write half equations for the reactions that occur at the electrodes when molten lead(II) bromide is electrolysed (**extended only**)

