“Electrolysis” How hard can it be?

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*“A simple guide for idiots.”*

*-Yehya Awad (Author)*

*“Perfect for idiots who know nothing about science.”*

*-www.review.com*

*“At first I was like ‘I don’t understand! Why can’t I understand!.’. But this guide changed everything! Idiots like me can finally have a chance to get a D.”*

*-Unknown*

**Electrolysis:**

First of all, what is [electrolysis](http://library.thinkquest.org/3347/electrolysis5.html)? Electrolysis is where you pass electricity through an [electrolyte](http://library.thinkquest.org/3347/electrolysis5.html), in this case salt water. When this is done, the water appears to be boiling, even though it's not very hot. Well, what's happening is much cooler and a lot different than boiling water. Let me explain...

This reaction is actually a [decomposition reaction](http://library.thinkquest.org/3347/reactypes.html#decomp). However, the result depends on the type of material you use for the [electrodes](http://library.thinkquest.org/3347/electrolysis5.html). For instance, using paper clips, which are mostly iron and copper, you get hydrogen gas and a compound of iron known as iron hydroxide. You get this result because of the process of decomposition. What actually happens is that the electricity breaks the water into hydride and hydroxide [ions](http://library.thinkquest.org/3347/electrolysis5.html). A hydride ion is practically a hydrogen atom without its electrons. Hydrogen does not want to stay an ion for long when it's free, so it joins up with another hydrogen atom to form hydrogen gas. The hydroxide ion combines with the iron (or copper) in your paper clips to form iron hydroxide. That's the green stuff that you see in your lid.

If you were to do this with carbon electrodes (such as the graphite in a pencil: graphite is dense carbon.), you get hydrogen gas and chlorine gas. You get the chlorine out of the salt water (because salt water is actually a solution of sodium and chlorine ions in water). The reaction produces hydroxide as well, but it displaces the chlorine in the solution. You can tell this is happening because the water becomes [basic](http://library.thinkquest.org/3347/electrolysis5.html) because sodium and hydroxide ions in water is a strong [base](http://library.thinkquest.org/3347/electrolysis5.html). The chlorine, because it's an ion, doesn't want to stay that way for long when it's alone, so it forms chlorine gas (You would recognize the smell of chlorine). The reason you get this result is because carbon, in its graphite form, is not [reactive](http://library.thinkquest.org/3347/electrolysis5.html), like metals are. Now you know!

Definitions:

* **Electrolyte:** A substance that conducts an electric current when molten or dissolved in water, with chemical reactions at the electrodes.
* **Non-Electrolyte:** A substance that does not conduct in the liquid phase.
* **Weak Electrolyte:** A poor conductor of electricity because it is only partially ionized – there are mainly molecules, few ions.
* **Strong Electrolyte:** A good conductor of electricity because it is completely ionized.
* **Electrolysis:** The process of passing an electric current through a substance and bringing about a chemical reaction.
* **Electrodes:** Pieces of metal or carbon through which the current enters and leaves the electrolyte.
* **Cathode:** The negative electrode.
* **Anode:** The positive electrode.

The Principle of Electrolysis:



1. Electrons flow from the battery to the cathode.
2. Positive ions (metallic or hydrogen) in the liquid are attracted to this negative electrode.
3. The positive ions accept electrons from the cathode, and metals or hydrogen are formed at the cathode.
4. Electrons flow from the anode to the battery or power supply.
5. Negative Ions (non-metals except hydrogen) are attracted to this positive electrode.
6. When the anode is inert (carbon or platinum) the negative ions lose electrons to the anode.

Examples of Electrolysis:

1st example:

Molten Sodium Chloride with inert electrodes

Ions present: Na+ , Cl-

Cathode:

Na+ + e- 🡪 Na-

2nd example:

Anode:

2Cl- - 2e- 🡪 Cl2

Aqueous copper (II) sulphate with carbon electrodes.

Ions present: Cu2+(aq), SO42-(aq), H+(aq) and OH-(aq)

Cathode:

Cu2+(aq) is lower than H+(aq) so

Cu2+(aq) + 2e- 🡪 Cu

Anode:

OH-(aq) is lower than SO42-(aq) so

4OH- - 4e- 🡪 O2 + 2H2O

**Past paper questions:**

**Question 1**

Describe what you would see when aqueous copper (II) sulphate is electrolyzed using carbon electrodes. [4 marks]

**Model answer:**

A colourless gas(1 mark), oxygen, is formed at the anode. A brown deposit of copper(1mark) at the cathode. The solution changes from blue(1 mark) to colourless(1 mark).

**Tips:**

Take care to answer the question. Here you must state what would be **seen.** You are advised to say what occurs at each electrode. Colourless is essential here, clear would be wrong – you can have a clear blue solution.

**Question 2**

Magnesium is manufactured by the electrolysis of its **molten** chloride. Explain why it cannot be obtained by the electrolysis of its aqueous chloride, by giving the reactions at the electrodes in both cases. [6 marks]

**Model answer:**

In an aqueous solution of magnesium chloride, Mg2+ and H+(1 mark) move to the cathode. Hydrogen is formed(1 mark).

At the cathode 2H+ + 2e- 🡪 H2 (1 mark) {The hydrogen ions are from the water.} The only positive ions in molten magnesium chloride are Mg2+(1 mark).

At the cathode Mg2+ + 2e- 🡪 Mg (1 mark)

At the anode (in both cases) 2CL- - 2e- 🡪 Cl2.

Extra’s

**Susan was in chemistry. Susan is no more, for what she thought was H2O was H2SO4.**

**A university professor set an examination question in which he asked what the difference between ignorance and apathy is. The professor had to give an A+ to a student who answered: “I don't know and I don't care.”
- Richard Pratt, Pacific Computer Weekly, 20 July 1990**

**At the end of the semester, a 10th-grade chemistry teacher asked her students what was the most important thing that they learned in lab. A student promptly raised his hand and said, "Never lick the spoon."**

**An electron sitting in a prison asked a second electron cellmate, "What are you in for?" To which the latter replied, "For attempting a forbidden transition."**

Some questions:

Q: Why do chemists call helium, curium and barium the medical elements?
A: Because if you can't helium or curium, you barium!

Q: If H-two-O is the formula for water, what is the formula for ice?
A: H-two-O-CUBED

Q: Why are chemists great for solving problems?

A: They have all the solutions

Resources:

* IGCSE Chemistry By Saad El-Din Nafei (Book)
* <http://www.bbc.co.uk/schools/gcsebitesize/chemistry/>
* Chemistry by Richard Harwood (book)
* [www.google.com](http://www.google.com)
* <http://www.coolscience.org/CoolScience/CoolJokes/ChemJokes.htm>

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