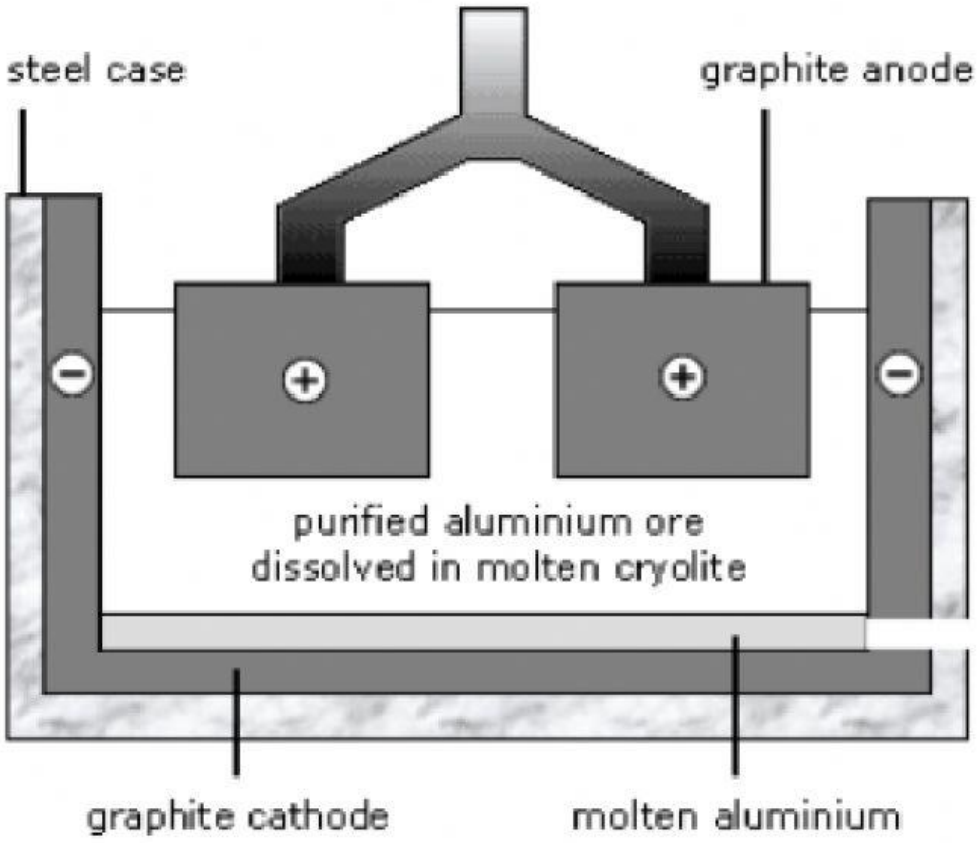
Electrolytic cell worksheet 3

Extraction of Aluminium

For this electrolytic cell we need to know a bit of theory first

1. Firstly, a metal ore containing Al is extracted (usually in Africa or South America). This ore is called **bauxite.**
2. This bauxite is then washed, crushed and dissolved in sodium hydroxide (NaOH) **caustic soda** to purify the Aluminium oxide (Al_2O_3).
3. The **alumina** (Al_2O_3) is then dissolved in **cryolite** (Na_3AlF_6) in order to decrease the melting point from 2000°C to between 900°C and 1000°C. (This saves on costs)

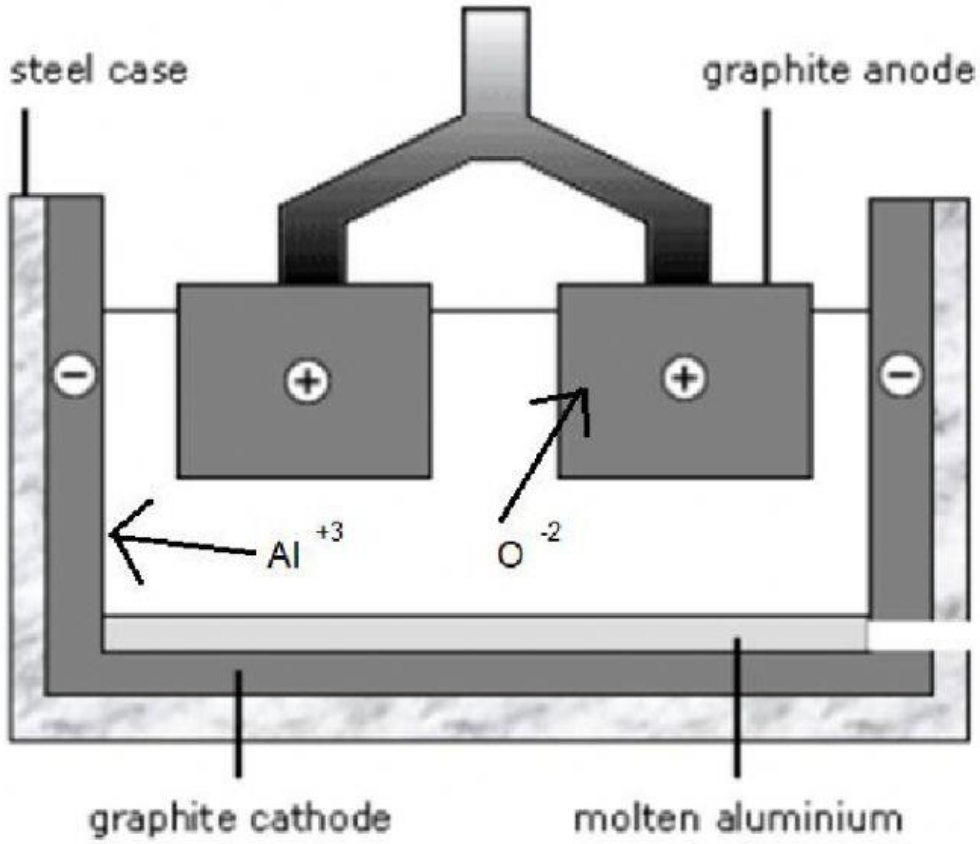
Electrolysis is then used to separate the oxygen and aluminium.



The anode is made up of graphite (a form of carbon)

The cathode is made of graphite and is the lining of the cell.

LIVEWORKSHEETS



At the anode:

Oxi: $2O^{2-}(l) \rightarrow O_2(g) + 4e^-$ (x3) {keep in mind this reaction is not on the standard reduction table – and thus needs to be memorised}

At the cathode:

Red: $Al^{+3}(l) + 3e^- \rightarrow Al(l)$ (x4)

Redox: $4\ Al^{+3}(l) + 6O^{2-}(l) \rightarrow 4Al(l) + 3O_2(g)$

Or (put the ions together before the arrow)

$2Al_2O_3(l) \rightarrow 4Al(l) + 3O_2(g)$

LIVEWORKSHEETS

Now remember the carbon electrodes are used because they are inert and a good conductor. Despite this when oxygen forms at the anode it ends up reacting with the carbon and forming $CO_2(g)$.

Why does this happen when it is not suppose to?

Because at such a high temperature, almost anything would start to react.

This causes the extraction of aluminium to be very bad for the environment for 2 reasons:

- Literally forming $CO_2(g)$ which is a greenhouse gas and it contributes to global warming.
- It uses a very large amount of electricity (which requires coal and thus adds to pollution)

Recycling scrap aluminium requires only 5% of the energy used to make new aluminium from the raw ore.

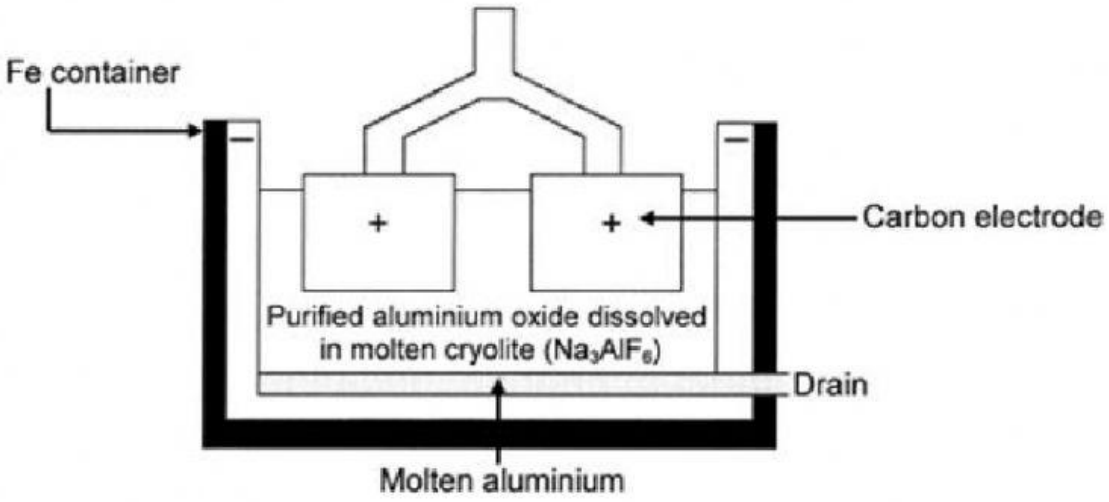
That's why is so important to recycle cans!

The nice thing about this electrolytic cell is that it can't change.

The oxidation and reduction half reactions will always be the same for the extraction of Aluminium.

LIVEWORKSHEETS

Exercise 1:



1.1 The energy conversion that takes place in this cell is

to energy

1.2 Is the Al formed at the positive or negative electrode

1.3 The anode is: positively negatively charged

1.3 Write the half reaction that occurs at the anode:

→ +

1.4 Write the half reaction that occurs at the cathode:

+ →

1.5 Write the balanced reaction to show how carbon dioxide forms at the anode:

+ →

LIVEWORKSHEETS