Electrolysis - GCSE Chemistry Cheat Sheet

by [deleted] via cheatography.com/56036/cs/15100/

Metal Ores

Haematite	Iron (Fe_2O_3)
Bauxite	Aluminium

What are metal ores?

Naturally occurring compounds containing high percentages of specific metals. Desirable metals are extracted from ore.

Methods of Metal Extraction

Depending on a metal's reactivity, different methods of extraction are used.

If the metal is **less reactive than carbon**, then a reduction reaction (involving carbon) is used. This works because the carbon forms compounds more readily, so it 'steals' the oxygen (similar to **displacement** reactions). An example of this is iron, which is extracted using a blast furnace.

If the metal is **more reactive than carbon**, electrolysis must be used, as the metal's compounds are very stable. An example of this is aluminium extraction.

Aluminium Extraction

1. **Bauxite** is purified to produce pure aluminium oxide (Al_2O_3).
2. The aluminium oxide is dissolved in **cryolite** (another aluminium ore). This introduces impurities, reducing the melting temperature of the mixture to 900$^{\circ}C$.
3. The aluminium oxide is melted.
4. When a current is passed through it, the positive Al^{3+} ions are attracted to the **cathode** (negative electrode), where they gain electrons. This is **reduction**.
5. The negative O^{2-} electrons are attracted to the **anode** (positive electrons), where they lose electrons and form oxygen or carbon dioxide. This is **oxidation**.

Half equations:

$Al^{3+} + 3e^- \rightarrow Al$

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

- Electrolysis is possible because the molten aluminium oxide contains free electrons, allowing it to conduct electricity.
- The electrodes are made of graphite because it is a good conductor.
- The anode must be replace regularly because it wears down through reactions with oxygen.

Iron Extraction

Reducing iron ore to iron:

1. Hot air is added to the blast furnace, as this makes the coke burn faster and elevates the temperature to around 1500$^{\circ}C$.
2. The coke burns and produces carbon dioxide.

   $C + O_2 \rightarrow CO_2$
3. The carbon dioxide reacts with any unburnt coke.

   $CO_2 + C \rightarrow 2CO$
4. The carbon monoxide reduces the iron ore to iron.

   $3CO + Fe_2O_3 \rightarrow 3CO_2 + 2Fe$

Purifying the resulting iron:

The main impurity is silicon dioxide (sand).

1. Limestone is thermally decomposed into calcium oxide.

   $CaCO_3 \rightarrow CaO + CO_2$
2. Calcium oxide reacts with silicon dioxide to form slag.

   $CaO + SiO_2 \rightarrow CaSiO_3$

- Coke is almost pure carbon.
- Slag is used in road building and fertilisers.