Electrolysis - GCSE Chemistry Cheat Sheet

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Metal Ores

Haematite	Iron (Fe2O3)
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 (Al2O3).
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:

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

$2O^{2-} \rightarrow O2 + 4e^{-}$

- 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.

   $C + O2 \rightarrow CO2$
3. The carbon dioxide reacts with any unburnt coke.

   $CO2 + C \rightarrow 2CO$
4. The carbon monoxide reduces the iron ore to iron.

   $3CO + Fe2O3 \rightarrow 3CO2 + 2Fe$

Purifying the resulting iron:

The main impurity is silicon dioxide (sand).

1. Limestone is thermally decomposed into calcium oxide.

   $CaCO3 \rightarrow CaO + CO2$
2. Calcium oxide reacts with silicon dioxide to form slag.

   $CaO + SiO2 \rightarrow CaSiO3$

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

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