Redox Reactions

Redox reaction

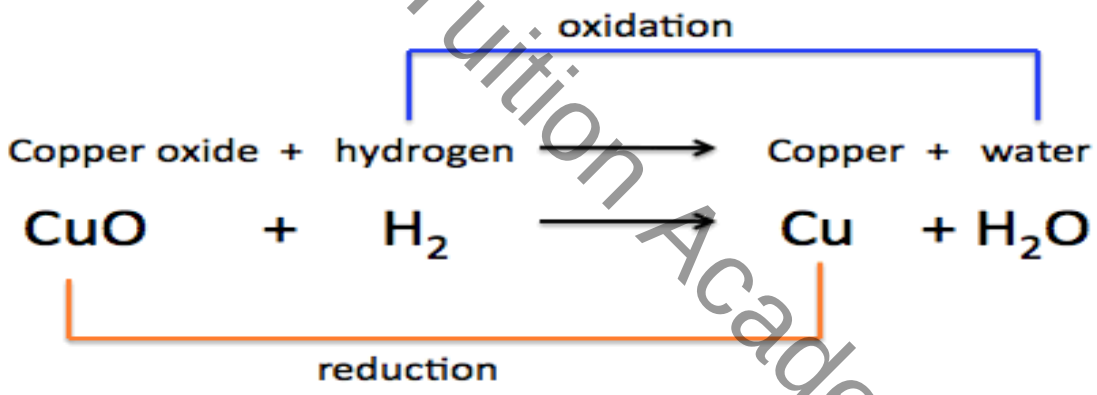
- A **redox** reaction is where oxidation and reduction take place together at the same time in the same reaction.

In terms of oxygen:

I. **Oxidation** is where **oxygen** is **added** to an element or a compound.
II. **Reduction** is where **oxygen** is **removed** from an element or compound

Example:

Copper oxide + hydrogen = copper + water



In term of Electrons:

- Most redox reactions involve elements other than oxygen. So reduction and oxidation are better defined in terms of the loss and gain of electrons

I. **Reduction** is the **gain of electrons** by a species in a chemical change.

II. **Oxidation** is the **loss of electrons** in a chemical change.

- A simple way to remember this is to use the term **OILRIG**

O Oxidation

I Is the

L Loss of electrons

R Reduction

I Is the

G Gain of electrons

➤ Another way to remember this just put the whole definition into reverse and remember **GIRLIO**

G Gain of electrons

I Is

R Reduction

L Loss of electrons

I Is

O Oxidation

Metals Displacement as Redox Reactions

Example 1:

when iron reacts with a compound of copper such as copper sulfate a displacement reaction occurs

iron + copper sulfate → iron(II) sulfate + copper

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

① We can write this as an **ionic equation**

$Fe + Cu^{2+} + SO_4^{2-} \rightarrow Fe^{2+} + SO_4^{2-} + Cu$

② The sulfate ions, SO_4^{2-}, appear on both sides of the equation unchanged.This means that they are spectator ions and do not participate in the chemistry of the reaction.So, they can be removed from the equation

$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$

③ This balanced **ionic equation** can be further split into two **half equations** illustrating oxidation and reduction individually

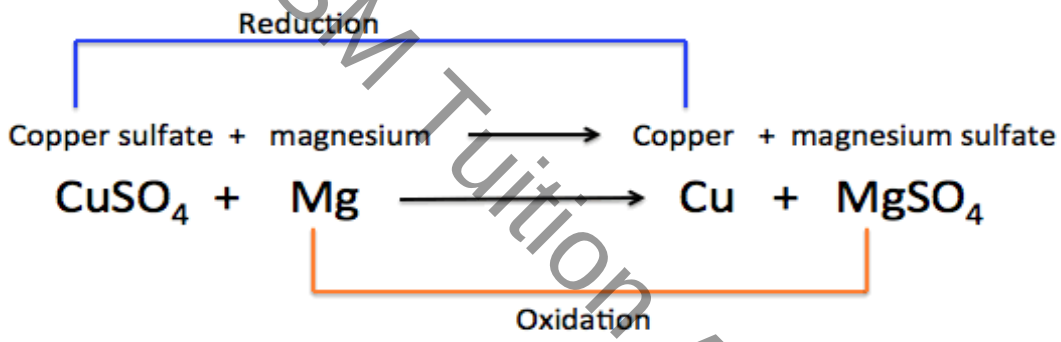
$Fe \rightarrow Fe^{2+} + 2e^-$ .....oxidation

$Cu^{2+} + 2e^- \rightarrow Cu$..... Reduction

④ The iron has lost electrons to become a positive ion, so has been oxidised
⑤ The positive copper ion has gained electrons to become an atom, so have been reduced

Example 2:

The reaction between a reactive metal like magnesium and copper sulfate solution (sometimes called a displacement reaction) is redox reaction.



Half equations show more clearly which species is reduced and which is oxidised.

Oxidation half equation: $Mg \longrightarrow Mg^{2+} + 2e^-$

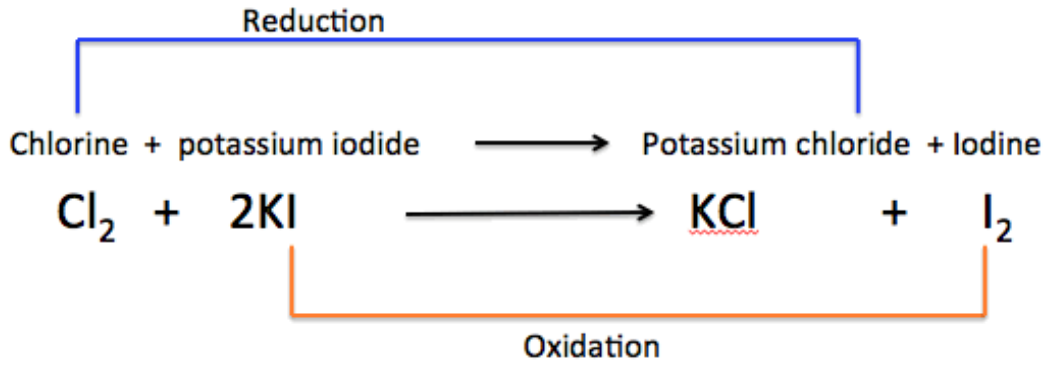
Reduction half equation: $Cu^{2+} + 2e^- \longrightarrow Cu$

Halogen displacement reactions

- A more reactive halogen can displace a less reactive halogen from solutions of its salts.
- For example, chlorine is more reactive than iodine. A solution of chlorine can displace iodine from potassium iodide solution:

chlorine + potassium iodide → potassium chloride + iodine

$Cl_2(aq) + 2KI(aq) \rightarrow 2KCl(aq) + I_2(aq)$



Half equations show more clearly which species is reduced and which is oxidised.

Oxidation half equation: $2I^- \longrightarrow I_2 + 2e^-$

Reduction half equation: $Cl_2 + 2e^- \longrightarrow 2Cl^-$