Chemistry 201

Oxidation number
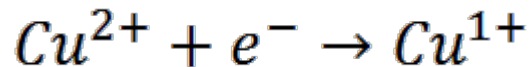
Oxidation number

Each ion involved a half reaction has an oxidation number indicated by the charge. One way to keep track of the oxidation and reduction nomenclature is to note that the oxidation number increases for oxidation

$$Fe^{2+} \leftrightarrow Fe^{3+} + e^{-}$$

and the oxidation number is reduced in a reduction.
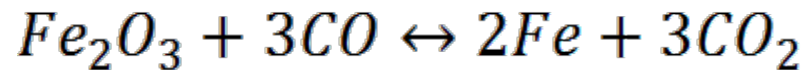
$$Cu^{2+} + e^{-} \rightarrow Cu^{1+}$$

Equivalent definition of oxidation

Oxidation is gain of oxygen.
Reduction is loss of oxygen.

For example, in the extraction of iron from its ore:

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

Because both **red**uction and **ox**idation are going on side-by-side, this is known as a **redox** reaction. in such reactions there is still a transfer of electrons, but it is disguised by the oxygen atom. Each oxygen carries an effective -2 charge in the bookkeeping of these electrons.

Oxidizing agent and reducing agent

An oxidizing agent oxidizes another species.
It is reduced in the process.

An reducing agent reduces another species.
It is oxidized in the process.

$$Fe_2O_3 + 3CO \leftrightarrow 2Fe + 3CO_2$$
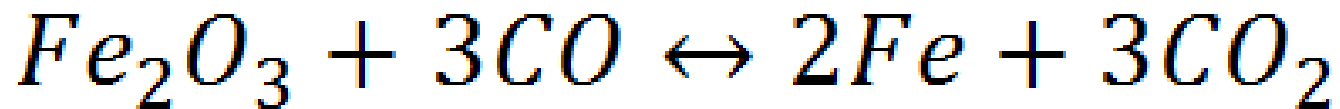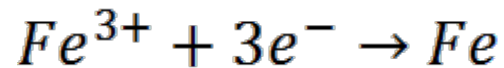
Oxidizing agent   Reducing agent   Reduced species   Oxidized species

Equivalent definition of oxidation

In this reaction iron is being reduced because it starts out in a 3+ oxidation state and ends up in a zero oxidation state

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

Although we normally do not think of carbon atoms as having a charge we can count charge using the rule that an O atom carries -2 charge. In this picture carbon has a +2 charge in CO and a +4 charge in CO_2. Carbon is effectively being oxidized in this process.

Showing the equivalence of oxygen and electron transfer

Let's look at an example, where the equivalence of electron transfer and oxygen transfer is obvious. We can consider the transfer of electrons from Cu^{2+} to Mg metal

$$Cu^{2+} + Mg \leftrightarrow Cu + Mg^{2+}$$

or from the oxide

$$CuO + Mg \leftrightarrow Cu + MgO$$
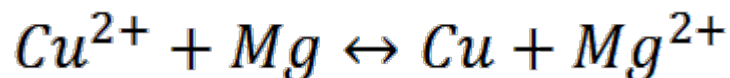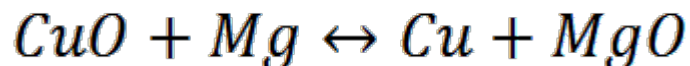
Here the oxygen transfer carries the 2 electrons involved in the redox process.