

11.20: Substances Which Are Both Oxidizing and Reducing Agents

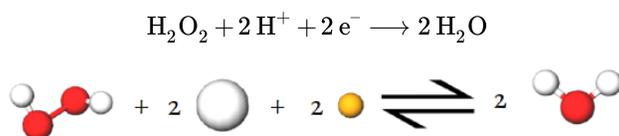
In the section on acids and bases, we saw that some substances can act as both an acid and a base ([amphiprotic](#)). In the world of redox chemistry there exist substances that can act as both a reducing agent and oxidizing and a couple of examples are given below.

Water

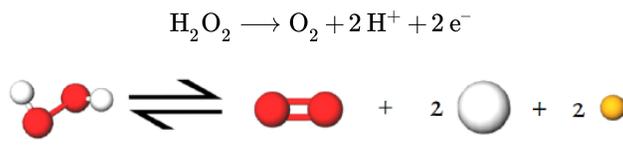
We have seen that [some oxidizing agents](#), such as fluorine, can oxidize water to oxygen. There are also [some reducing agents](#), such as lithium, which can reduce water to hydrogen. In terms of redox, water behaves much as it did in [acid-base reactions](#), where we found it to be [amphiprotic](#). In the presence of a strong electron donor (strong reducing agent), water serves as an oxidizing agent. In the presence of a strong electron acceptor (strong oxidizing agent), water serves as a reducing agent. Water is rather weak as an oxidizing or as a reducing agent, however; so there are not many substances which reduce or oxidize it. Thus it makes a good solvent for redox reactions. This also parallels water's acid-base behavior, since it is also a very [weak acid](#) and a very [weak base](#).

Hydrogen peroxide (H_2O_2)

In this molecule the [oxidation number](#) for oxygen is -1 . This is halfway between $O_2(0)$ and $H_2O(-2)$, and so hydrogen peroxide can either be reduced or oxidized. When it is reduced, it acts as an oxidizing agent:



When it is oxidized, it serves as a reducing agent:



Hydrogen peroxide is considerably stronger as an oxidizing agent than as a reducing agent, especially in acidic solutions.

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