

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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