

## GUIDELINES FOR ASSIGNING OXIDATION NUMBERS

**Oxidation** is an increase in oxidation number while **reduction** is a decrease in oxidation number. In order to recognize these processes, one must be able to assign proper oxidation numbers to the various elements associated with a particular chemical reaction. Remember that **oxidation number**, or **oxidation state**, is a bookkeeping device used to track electron transfer. The following guidelines will assist in assigning oxidation numbers.

chemical species	oxidation number
elemental form (e.g., Cu or Br <sub>2</sub> )	zero
monatomic ion (e.g., Na <sup>+</sup> or S <sup>2-</sup> )	charge on monatomic ion
chemically combined hydrogen	+1 (notable exception is in a metal hydride such as NaH where ox. no. = -1)
chemically combined oxygen	-2 (notable exception is in a peroxide such as H <sub>2</sub> O <sub>2</sub> where ox. no. = -1)

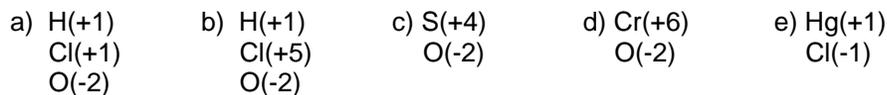
The sum of the oxidation numbers of all atoms in a given chemical species is equal to the net charge on the species.

### Practice

1. Assign oxidation numbers to all atoms in each of the following.



### Answers



## GUIDELINES FOR BALANCING REDOX EQUATIONS

The method presented here is similar to the half-reaction method that is described in the text. It is easy to apply to redox reactions which take place in aqueous solution, however, one must be careful to follow the sequence of steps exactly.

1. Assign oxidation numbers to all atoms in the equation and determine which substance is being oxidized and which is being reduced (from changes in oxidation numbers). Write separate half-reactions for each process.
2. Balance each half-reaction in the following way.
  - a) By using appropriate coefficients, balance all atoms other than hydrogen and oxygen in the basic half-reaction. If hydrogen and/or oxygen are being oxidized or reduced, these atoms should be balanced as well. Keep in mind that atoms, except for hydrogen and oxygen as noted below, may appear in the half-reaction only in the form of substances indicated in the original equation.
  - b) Add the necessary number of electrons (to account for the change in oxidation number) to the appropriate side of the equation; to the reactants' side if it is a reduction half-reaction, and to the products' side if it is an oxidation half-reaction.
  - c) Balance charge by the addition of  $\text{H}^+$  ions, if the reaction is in acidic solution, or  $\text{OH}^-$  ions, if the conditions are basic.
  - d) Balance the hydrogen and oxygen atoms by the addition of water.
3. Combine the balanced half-reactions so that the electrons cancel exactly on each side of the final equation. This may necessitate multiplying one or both half-reactions by some integer to equalize the number of electrons involved in each half-reaction.
4. Cancel substances common to both sides of the equation.
5. Check to see if both atom and charge balance have been achieved.