<u>Rules For Assigning Oxidation States</u>

1. For free elements the oxidation state is zero.
   e.g. $Fe(s)$, $O_2(g)$, $O_3(g)$, $H_2(g)$, $Hg(l)$, $Hg(g)$, $S(s)$ etc.

2. For monoatomic ions, the oxidation state is given by the charge on the ion.
   e.g. Cl^- (**-1**), Fe^{2+} (**+2**), Fe^{3+} (**+3**), S^{2-} (**-2**), Ca^{2+} (**+2**), H^+ (**+1**) etc

3. Certain elements when present in compounds have common oxidation states.

   a) alkali metals (Li^+, Na^+, K^+) are always **+1**

   b) alkali earth metals (Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}) are always **+2**

   c) hydrogen is **+1** (except in metal hydride compounds such as LiH)

   d) oxygen is **-2** (except in peroxides such as H_2O_2)

   e) halogens (F^-, Cl^-, Br^-, I^-) are usually **-1**

4. The sum of the oxidation states in a molecule is zero.
   e.g. CH_2O (**0**) + 2(**+1**) + (**-2**) = 0
   CH_3OH (**+2**) + 3(**+1**) + (**-2**) + (**+1**) = 0

5. The sum of the oxidation states in an ion is equal to the charge on the ion.
   e.g. $CH_3CH_2O^-$ (**-3**) + 3(**+1**) + (**-1**) + 2(**+1**) + (**-2**) = -1
   CH_3CO_2- (**-3**) + 3(**+1**) + (**+3**) + 2(**-2**) = -1

Organic Compounds:

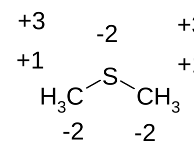
Assigning oxidation states to organic compounds proceeds by a process of deduction, in which bonds are hypothetically broken removing the more electronegative atom with the corresponding electron pairs. Proceed to remove all atoms around carbon assigning oxidation states to H (+1), O (-2) and halogens (-1) until oxidation state of the central carbon atom in determined. For bonds between identical elements (eg. C-C), the bond is broken homolytically, in which case no contribution is made to the oxidation state.

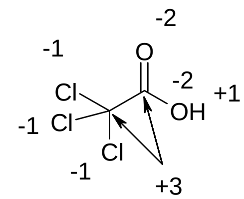
Note: Oxidation corresponds to an increase in the oxidation state and reduction corresponds to a decrease in the oxidation state.

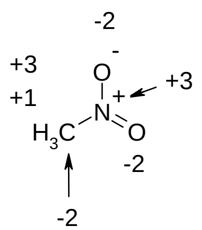
Sample Exercises:

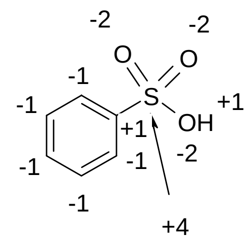
1. Determine the oxidation states for all of the atoms in each of the following:

a) CH_3SCH_3 (dimethyl sulfide)
b) Cl_3CCO_2H (trichloroacetic acid)
c) CH_3NO_2 (nitromethane)
d) $C_6H_5SO_3H$ (benzenesulfonic acid)

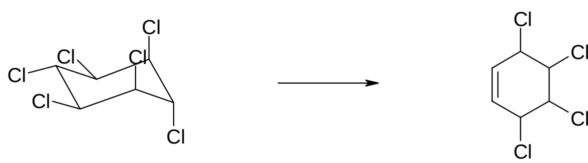




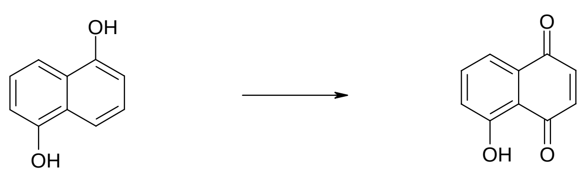


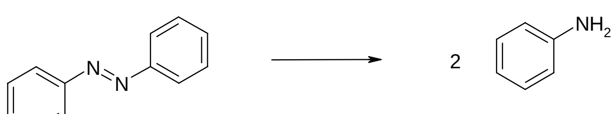


2. Indicate whether the following processes involve oxidation or reduction and indicate the number of electrons transferred in each case.



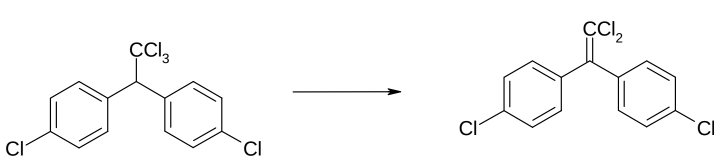
linane





azobenzene

aniline



DDT

DDE