

HW13, Oxidation

Oxidation number (oxidation state) is a formal concept. Generally, it's the most effective way to figure out chemical formulas of the compounds.

1. If the compound is ionic, the charges on the ions are the oxidation number, although the sign will go first. E.g. KCl, charges 1+ for K and 1- for Cl, oxidation number for K +1, for Cl -1. If the compound is covalent we will assign oxidation number, pretending that it's ionic. E.g. CH₄, for C oxidation number is -4, for hydrogen +1. The resulting oxidation number of the molecules – 0.
2. The most electronegative atom in a molecule is assigned a negative oxidation number. E.g. CO₂. It is a covalent compound. O is the more electronegative element and it needs to gain 2 electrons to have a full outer shell, the oxidation number will be -2. Carbon oxidation number in this compound will be +4.
3. The oxidation number of atoms in a "truly" covalent compound is 0. E.g. oxidation number of oxygen in O₂ is 0.
4. The elements in groups 1 and 2 have the group number as their oxidation number.
5. The maximum possible oxidation number for an element will be its group number for groups 1 and 2. For elements in groups 13-17 the oxidation number = the group number – 10. It is not possible to lose more electrons than there are in the outer shell.

Examples:

H₂O – hydrogen +1, oxygen -2 (+1x2-2=0). Water is polar covalent compound. We "pretend" that it's ionic compound, where hydrogens lose electrons (each one loses one electron), and oxygen gains two electrons.

NaCl – Na +1, Cl -1 (1-1=0). Sodium chloride – ionic compound, sodium loses electron, chlorine gains electron.

Fe₂O₃ - Fe +3, O -2 (2x3+3x(-2)=0)

CaO – Ca +2, O -2

Na₂O – Na +1, O -2

Oxidation – loss of electrons

Reduction – gain of electrons

If something loses electrons, something else must gain them. And these processes happen together. If something is oxidized (loses electrons), something else must be reduced (gains electrons).

Questions

1. Work out the oxidation number of chlorine in the following compounds: Cl₂O, ClO₄⁻, HClO₃, ClF₃.
2. The following elements react: 1) Sb and N, 2) Al and Cl. Using periodic table of elements predict which one in each of these couples will be reduced (acquire electrons) and which one will be oxidized (lose electrons). Explain your answer.