

Electron Transfer Reactions

Objectives

1. To learn about metal-nonmetal oxidation–reduction reactions
2. To learn to assign oxidation states

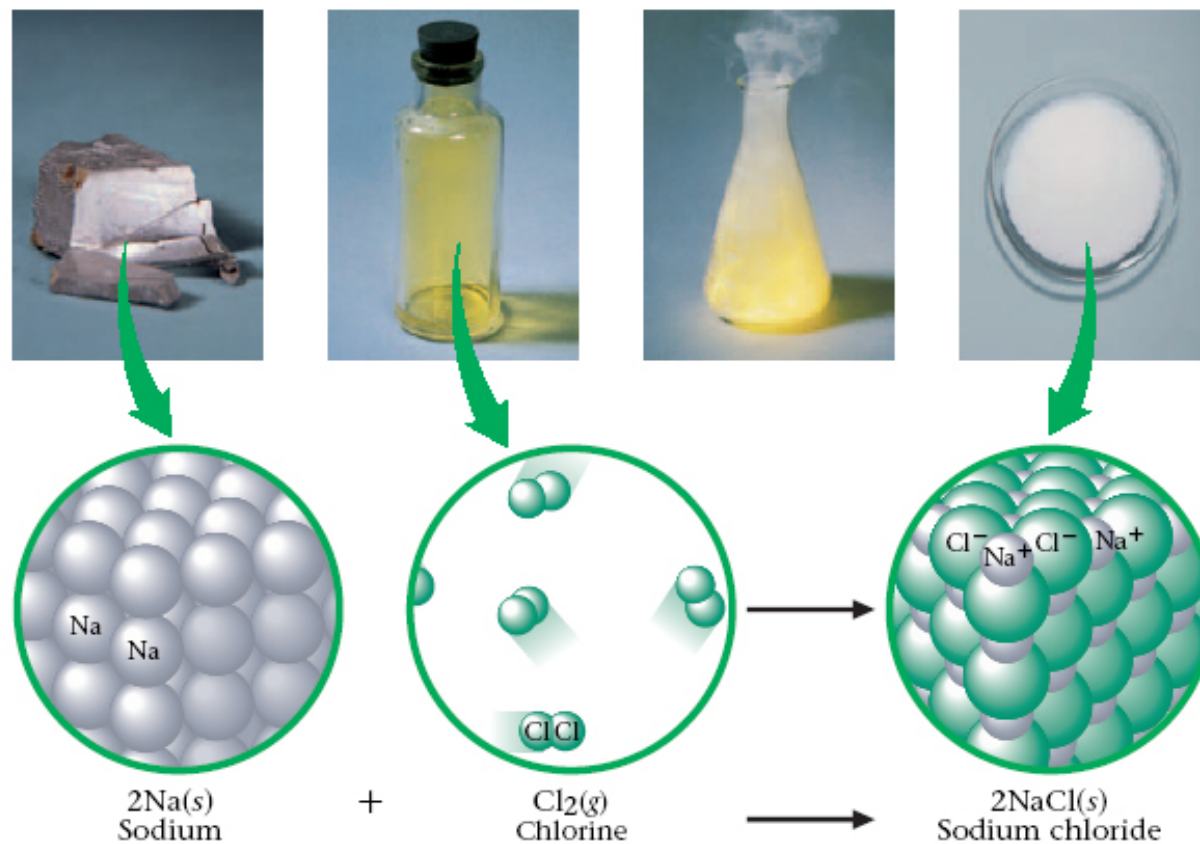
Electron Transfer Reactions

A. Oxidation-Reduction Reactions

- **Oxidation-reduction reaction** – a chemical reaction involving the transfer of electrons
 - **Oxidation** – loss of electrons
 - **Reduction** – gain of electrons

Electron Transfer Reactions

A. Oxidation-Reduction Reactions



- Which element is oxidized?
- Which element is reduced?

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B. Oxidation States

- **Oxidation states** – allow us to keep track of electrons in oxidation-reduction reactions

Rules for Assigning Oxidation States

1. The oxidation state of an atom in an uncombined element is 0.
2. The oxidation state of a monatomic ion is the same as its charge.
3. Oxygen is assigned an oxidation state of -2 in most of its covalent compounds. Important exception: peroxides (compounds containing the O_2^{2-} group), in which each oxygen is assigned an oxidation state of -1 .
4. In its covalent compounds with nonmetals, hydrogen is assigned an oxidation state of $+1$.
5. In binary compounds, the element with the greater electronegativity is assigned a negative oxidation state equal to its charge as an anion in its ionic compounds.
6. For an electrically neutral compound, the sum of the oxidation states must be zero.
7. For an ionic species, the sum of the oxidation states must equal the overall charge.

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B. Oxidation States

Table 18.1

Examples of Oxidation States

Substance	Oxidation States	Comments
sodium, metal, Na	Na, 0	rule 1
magnesium sulfide, MgS	Mg, +2 S, -2	rule 2 rule 2
carbon monoxide, CO	C, +2 O, -2	rule 3
sulfur dioxide, SO ₂	S, +4 O, -2	rule 3
hydrogen peroxide, H ₂ O ₂	H, +1 O, -1	rule 3 (exception)
ammonia, NH ₃	H, +1 N, -3	rule 4 rule 5
hydrogen sulfide, H ₂ S	H, +1 S, -2	rule 4 rule 5
sodium carbonate, Na ₂ CO ₃	Na, +1 O, -2 C, +4	rule 2 rule 3 For CO ₃ ⁻² , the sum of the oxidation states is +4 + 3(-2) = -2. rule 7