Redox Reactions

What is an oxidation-reduction reaction?

- A reaction in which electrons are transferred from one atom to another.

- Called redox reactions for simplicity

Oxidation

- The process by which electrons are removed from the atom.
- $Na \rightarrow Na^+ + e^-$

Reduction

- The process by which any atom or ion gains electrons.
- $Cl_2 + 2e^- \rightarrow 2Cl^-$

Example

- Chemical equation: $2K + Br_2 \rightarrow 2KBr$
- Net Ionic equation: $2K + Br_2 \rightarrow 2K^+ + 2Br^-$
- The potassium has lost electrons
  - Oxidized
- The bromine gains electrons
  - Reduced

Oxidizing Agent

- The substance that oxidizes another substance by accepting the electrons
- This is the substance that is reduced in the reaction

Reducing Agent

- The substance that reduces another substance by losing electrons
- A reducing agent supplies electrons to the substance getting reduced
  - Thus, it is oxidized

- So in our example,
- Chemical equation: $2K + Br_2 \rightarrow 2KBr$
- Potassium is oxidized, therefore bromine is the oxidizing agent
- Bromine is reduced, therefore potassium is the reducing agent

Oxidation Number

- In complex reactions it is not always obvious what is being oxidized or reduced
- Chemists developed a set of rules to assign oxidation numbers to elements to better see what is being oxidized or reduced
  - If the substance is oxidized, its oxidation number increases
  - If the substance is reduced, its oxidation number decreases

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Balancing Redox Equations using Oxidation Numbers

1. Assign oxidation numbers to all atoms in the equation.
2. Identify the atoms that are oxidized and the ones that are reduced.
3. Determine the change in oxidation number for the atoms that are oxidized and for the atoms that are reduced.
4. Make the change in oxidation numbers equal in magnitude by adjusting coefficients in the equation.
5. If necessary, use the conventional method to balance the remainder of the equation.

Balancing Redox Reactions in Acidic Solutions
(Half-Reaction Method)

1. Divide the equation into two half- reactions
2. Balance both equations by inspection ignoring any oxygen and hydrogen atoms
3. Balance oxygen atoms by adding water molecules
4. Balance the hydrogen atoms by adding hydrogen ions
5. Balance the charges by adding electrons
6. Multiply each half-reaction by the smallest whole number required to balance the electrons
7. Add the two half reactions and reduce

Balancing Redox Reactions in Basic Solutions
(Half-Reaction Method)

1. Balance the equation as if it were in an acid solution
2. Add enough OH^- ions to each side to cancel the H^+ ions (Be sure to add the OH^- ions to both sides to keep the charge and atoms balanced)
3. Combine the H+ and OH- ions (on the same side) to make water
4. Simplify the net equation by cancelling or combining water molecules