Redox Reactions

Reduction/Oxidation and Potentials

In redox reactions, charge is transferred between reactants and products in the form of electrons

However, the best way to understand redox reactions is to understand the significance of electrons and Oxygen in the reduction and oxidation of reagents in reactions

The MCAT will often blend metabolism, chemical gradients, and redox concepts when testing this topic

Oxidation Numbers

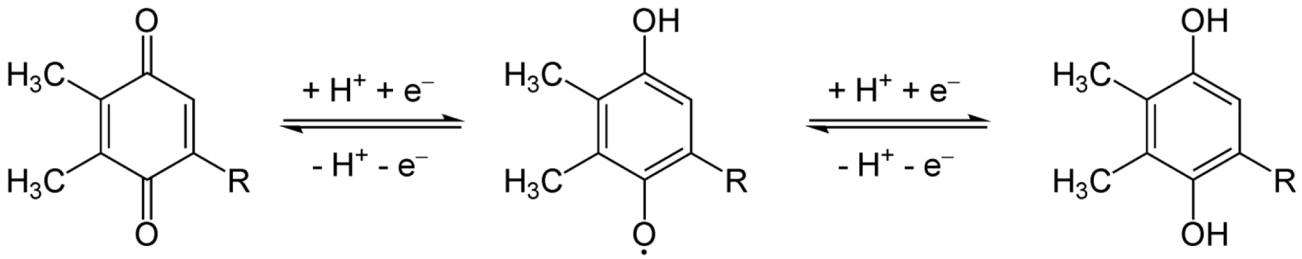
Oxidation numbers are assigned based on conventional guidelines:

- Free Elements (Br_2, O_2, etc.) are zero
- Monatomic ions are equal to their ionic charge
- Group IA and Group IIA elements are +1, +2, respectively
- Group VIIA elements are always -1 except in the presence of a more electronegative element (e.g., OF_2, O is +2 and F is -1)
- Hydrogen is +1 in the presence of electronegative elements and -1 in the presence of electropositive elements (H_2O vs CH_4). Likewise for Oxygen
- In a molecule, the total molecular oxidation number is the sum of the individual oxidation numbers
  - In a neutral compound, **sum = 0**. In a polyatomic ion, **sum = formal charge**

Important Facts

- **Oxidation (Anode)**: loss of e^-
- **Reduction (Cathode)**: gain e^-
- **Reducing Agent**: reduces others; gets oxidized
- **Oxidizing Agent**: oxidizes others; gets reduced

Mnemonic: OIL RIG (Oxidation Is Loss, Reduction Is Gain



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(Wikimedia commons)

Redox reaction concepts will most likely come up as biochemical reactions, such as the reduction or oxidation of Plastoquinone, shown above

- Note that as the molecule is reduced, protons bind to the oxygen
- Electrons can usually be followed in a biochemical reaction by following protons

Balancing Ionic Equations

For balancing:

1. Separate core reagents into reduction and oxidation half reactions
2. Balance O_2 for each ½ rxn—add H_2O and H^+ for acidic and H_2O and OH^- for basic solutions
3. Balance the charge for each half by adding e^-
4. Multiply either or both half reactions to cancel out the e^-, add the half reactions

Consider the example:

$MnO_4^- + I^- \rightarrow I_2 + Mn^{2+}$ (Basic reaction)

$2\ MnO_4^- + 16\ H^+ + 10\ I^- \rightarrow 2\ Mn^{2+} + 5\ I_2 + 8\ H_2O$ (Fully Balanced)