Classification of Reagents in Chemistry III:
Oxidizing and Reducing Agents

- Oxidation-reduction reactions (redox reactions) involve the transfer of electrons from one atom to another.

- All redox reactions involve one element gaining electrons (being reduced) and one element losing electrons (being oxidized).

- Disproportionation reactions have the same element being both oxidized and reduced.

- There are several mnemonics that can help with the direction of electron movement such as OiL RiG (oxidation is loss of electrons, reduction is gain of electrons) or LEO the lion goes GER (lose electrons: oxidation, gain electrons: reduction).

Reducing Agents – Reducing agents cause something to be reduced (gain electrons) and are themselves oxidized (lose electrons).

Common Reducing Agents – H_2 (esp. w/ metal surface catalyst), $LiAlH_4$, $NaBH_4$, $LiBH_4$, KH, $NaBH_3CN$, $(CH_3)_2S$, Li, Na, K, Cs, Mg, Zn, and Ca. (Note: Many reducing agents react with air, often violently, as air contains the oxidizing agent oxygen.)

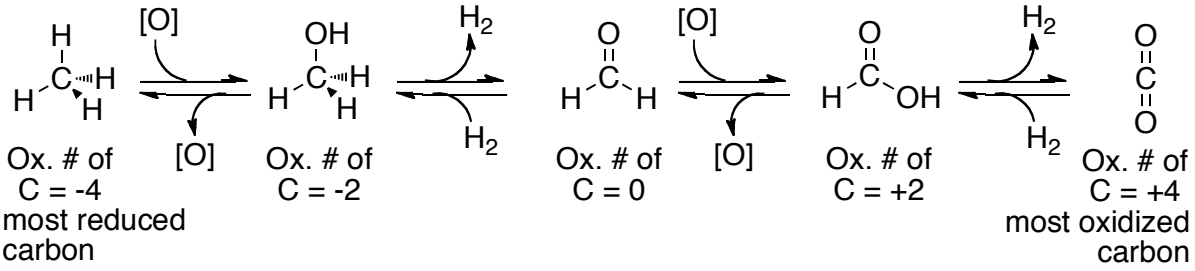
Oxidizing Agents – Oxidizing agents cause something to be oxidized (lose electrons) and are themselves reduced (gain electrons).

Common Oxidizing Agents - O_2, O_3, F_2, Cl_2, Br_2, I_2, NO_3^-, $MnO_4^=$, H_2CrO_4 (aq), Cr^{6+} salts, H_2O_2, NaClO (bleach), MnO_2, pyridinium chlorocromate (PCC), Jones reagent, Dess-Martin Reagent, and TPAP.

Organic Redox Reactions – Organic redox reactions do not involve ions so, while assignment of oxidation numbers still shows electron movement, the direction of the redox is classified by bond number and type.

Oxidation –	Gain of bonds to an electronegative atom (e.g. O, F, or Cl,) Loss of bonds to H
Reduction –	Gain of bonds to H Loss of bonds to an electronegative atom (e.g. O, F, or Cl,).

General Process of Organic Redox Reactions:



Inorganic Redox Reactions – There are many kinds of inorganic reactions that fall under the category of redox, the assignment of oxidizing agent and reducing agent is determined by assignment of oxidation numbers. (See Oxidation Numbers Handout)

- Single replacement (Activity series of metals)
  M^{2+} (aq) + E (s) → E^{2+}(aq) + M (s)
  Cu^{2+} (aq) + Zn (s) → Zn^{2+}(aq) + Cu (s)

- Combination/Synthesis Reactions
  Element + Element → compound
  S (s) + O_2 (g) → SO_2 (g)

- Combustion (a special synthesis reaction)
  C_xH_y + O_2 (g) → CO_2 (g)+ H_2O (g)

- Decomposition
  Compound → element + element
  2 HgO (s) + heat → 2 Hg (l) + O_2 (g)

- Aqueous Redox / Complex Redox
  Involve water and acid/base. See handout on aqueous redox reactions.