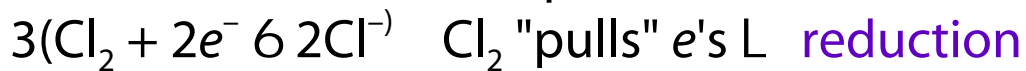
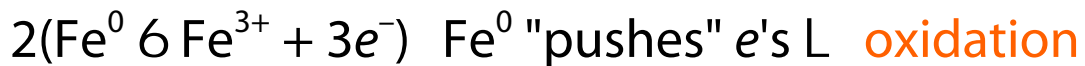


## Oxidation-Reduction (Redox) Reactions

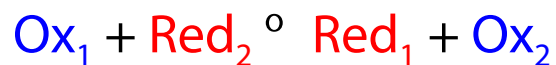
- L A reaction in which one species transfers electrons to another is an **oxidation-reduction reaction**, also called a **redox reaction**.



- T Oxidation is the **loss** of electrons by a substance.
- T Reduction is the **gain** of electrons by a substance.
- K **There is never an oxidation without a reduction, and vice versa!**

## Oxidizing Agents and Reducing Agents

- T An **oxidizing agent** (or **oxidant**) is a substance that causes another substance to be oxidized and is itself reduced.
- T A **reducing agent** (or **reductant**) is a substance that causes another substance to be reduced and is itself oxidized.
- L In these terms, all redox reactions take on the general form



## Rules for Assigning Oxidation Numbers

- L **Oxidation numbers** are real or hypothetical charges on atoms, assigned by the following rules:
1. Atoms in elements are assigned 0.
  2. All simple monatomic ions have oxidation numbers equal to their charges. (e.g., all Group IA ions are +1; all group IIA ions are +2; all the following ions have oxidation numbers given by their charges -  $\text{Fe}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{S}^{2-}$ ,  $\text{N}^{3-}$ )
  3. Fluorine is always -1 in its compounds.
  4. Halogens are usually -1, except when a central atom or when combined with a more electronegative element (e.g., assign I as -1 in  $\text{NI}_3$ , but +3 in  $\text{ICl}_3$ ).
  5. Oxygen is -2 in most of its compounds, except in cases like peroxides ( $\text{H}_2\text{O}_2$ ,  $\text{Na}_2\text{O}_2$ ) where it is -1.
  6. Hydrogen is usually +1, except in hydrides with electropositive elements, particularly with metal cations, where it is -1 (e.g.,  $\text{NaH}$ ,  $\text{CaH}_2$ ,  $\text{BH}_4^-$ ).
  7. The sum of all oxidation numbers for a neutral compound is zero; the sum is the charge on the species for a complex ion.

## Oxidation-Reduction and Oxidation Numbers

- P When a species is oxidized, one of its atoms goes to a higher (more positive or less negative) oxidation number.
- P When a species is reduced, one of its atoms goes to a lower (less positive or more negative) oxidation number.

