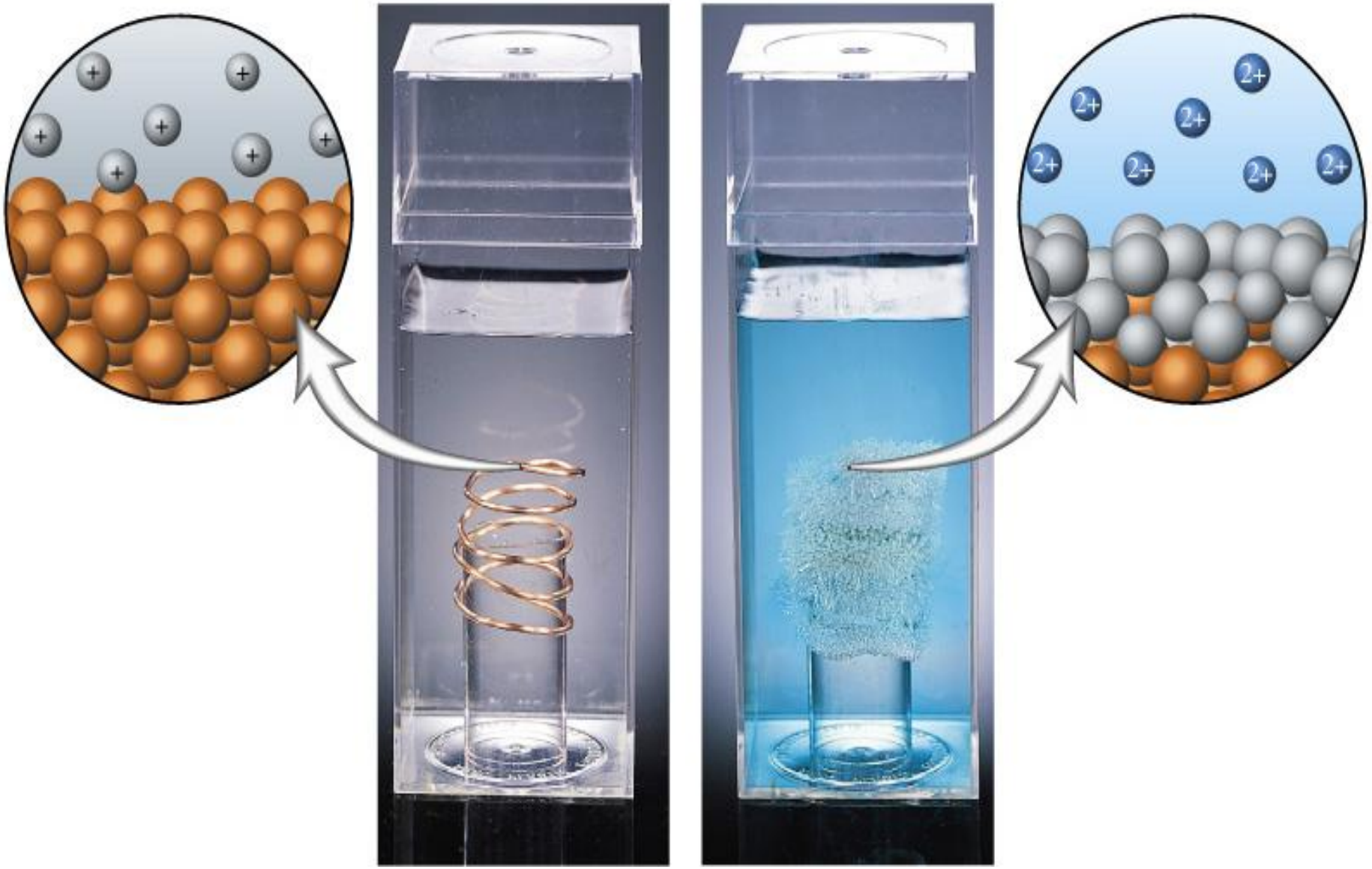
Electron Transfer Reactions

Chapter 9.1

Oxidation-Reduction: Transfer of Electrons



Definitions

- **Oxidation** is the process in which one or more electrons is lost by a chemical entity (also defined as an increase in oxidation number)
- **Reduction** is the process in which one or more electrons is gained by a chemical entity (also defined as a decrease in oxidation number)

Loss of electrons is oxidation
Gain of electrons is reduction

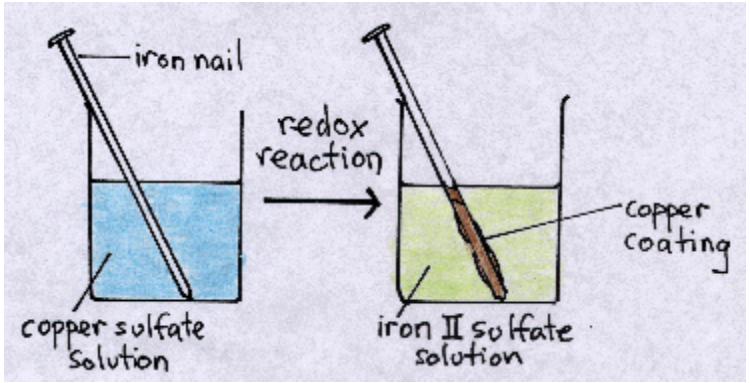
- An **Oxidation-Reduction (redox) reaction** is a reaction in which one or more electrons are transferred between chemical entities

Half-Reaction Equations

- A **half-reaction equation** is the part of an oxidation-reduction reaction equation representing either the oxidation reaction or the reduction reaction

Practice

- Write the oxidation and reduction half-reaction equations for the following redox reaction



$$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$$

Oxidation Numbers

- An **oxidation number (oxidation state)** is a number used to keep track of electrons in oxidation-reduction reactions according to certain rules
- An atom's oxidation number is the positive or negative charge on the atom if the electron pairs in a covalent bond belong only to the more electronegative atom

Rules for Assigning Oxidation Numbers

1. The sum of the oxidation numbers in a neutral compound is equal to zero
2. The sum of the oxidation numbers in a polyatomic ion is equal to the ion's overall charge
3. The oxidation number of an element in its native state is zero
4. The oxidation number of a monatomic ion is the same as its charge
5. O is usually -2 (except for peroxides where is is -1)
6. H is usually +1 (except for hydrides where it is -1)
7. The periodic table can be used as a *guide* for an atom's oxidation number in a compound (ex: F is usually -1, alkali metals are usually +1)

Practice

- Assign an oxidation number to each element in the following compounds:

a) Ga_2O_3

b) K_2MnO_4

c) $H_2PO_4^-$

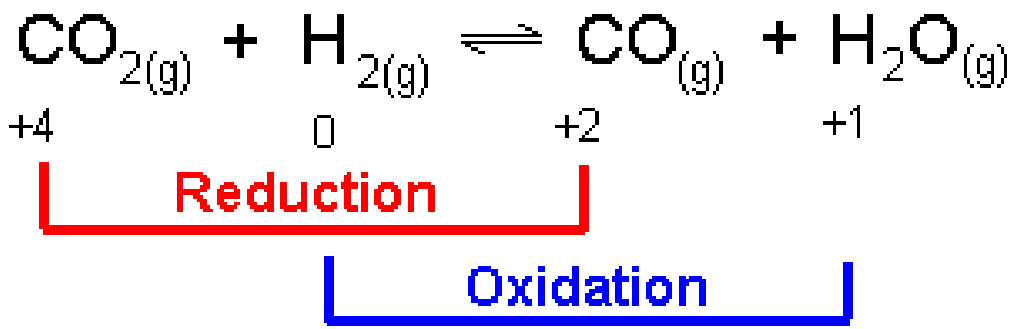
d) $Fe_2(CrO_4)_3$

e) $Hg_2(BrO_3)_2$

f) $KClO_4$

Oxidation Numbers in Redox Reactions

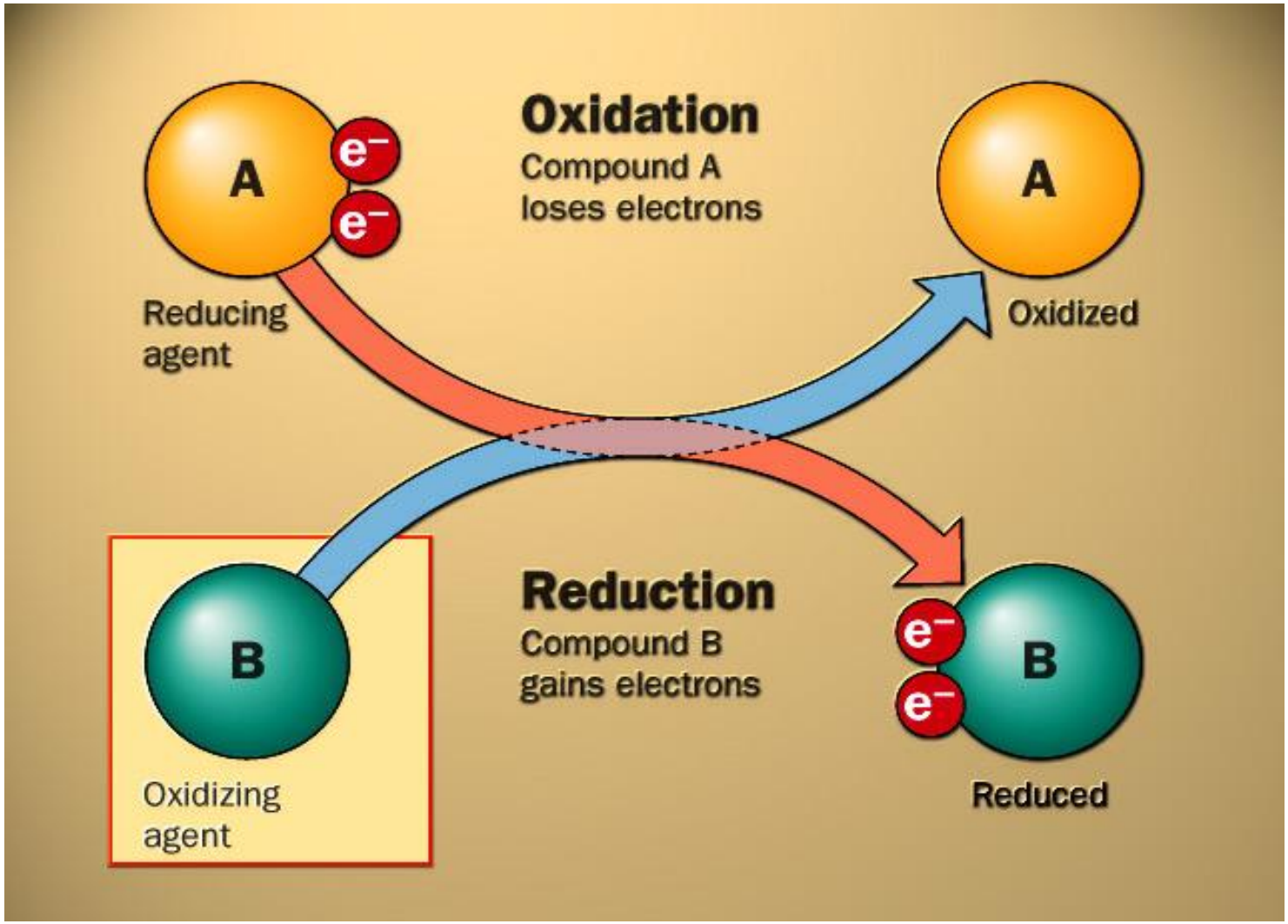
- Assigning oxidation numbers to each atom in all reactants and products of a redox reaction can help us determine where the oxidation and reduction are taking place



Oxidizing Agents and Reducing Agents

- An **oxidizing agent** is the reactant that is reduced (gains electrons from another substance) during an oxidation-reduction reaction
- A **reducing agent** is the reactant that is oxidized (loses electrons to another substance) during an oxidation-reduction reaction

Summary


A
e⁻
e⁻
Reducing agent
Oxidation
Compound A loses electrons
A
Oxidized
B
Oxidizing agent
Reduction
Compound B gains electrons
e⁻
e⁻
B
Reduced

Practice

- $WO_3(s) + 3\ H_2(g) \rightarrow W(s) + 3\ H_2O(l)$

  - »Element oxidized –
  - »Element reduced –
  - »Oxidizing agent –
  - »Reducing agent –

Practice

- $SnO_2(s) + 2\ C(s) \rightarrow Sn(l) + 2\ CO(g)$

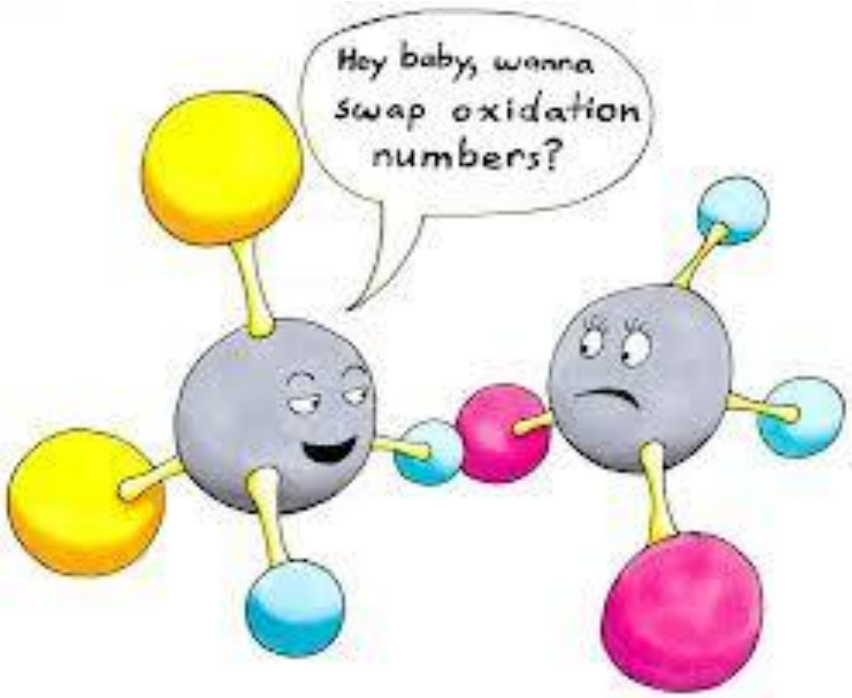
  - »Element oxidized –
  - »Element reduced –
  - »Oxidizing agent –
  - »Reducing agent –

HOMEWORK

Required Reading:

p. 598-607

(remember to supplement your notes!)



Questions:

p. 601 #1-4

p. 604 #1-4

p. 606 #1-3

p. 607 #1-10