

-Exchange Rxns (**Precipitation and Acid-base**) do **not** have oxidation number change.

-Redox Rxns do have oxidation number change:

-each single atom in a molecule has own oxidation number

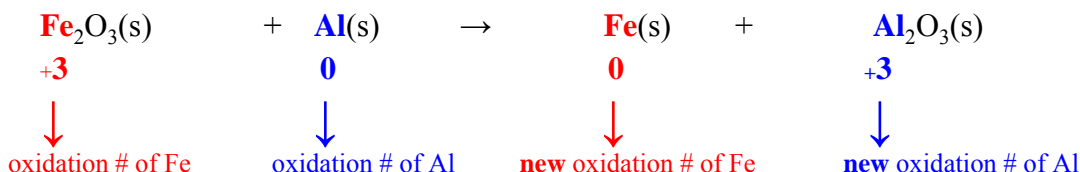
-redox rxns can occur as a single replacement, a formation of compound from elements, decomposition of a compound into elements, or combustion

### Redox Rxns:

-**electrons** (which have a negative charge) are transferred between two atoms. For every **reduction process** (actually called a half-reaction), there is an **oxidation process** (other half-reaction) because one atom gives an electron away and another one must pick it up.

-when an acceptor picks up electrons, it is **reduced** (think “going in the negative direction on the number line” in terms of the oxidation number). In contrast, the electron donor is **oxidized**, where its oxidation number increases.

Ex: Iron (III) oxide + aluminum



- as the **iron oxide** and **aluminum** react, aluminum gives iron 3 electrons. Iron is being reduced and aluminum is being oxidized. The species that donates electrons is called the **reducing agent** (in this case it is Al) and the species that receives the electrons is the **oxidizing agent** (in this case, Fe<sub>2</sub>O<sub>3</sub>).

\*when naming the reducing or oxidizing agents, you have to name the whole compound in which the element being reduced or oxidized

### Activity Series

-this is a chart showing which metals are most and least reactive (ie, most and least easily oxidized to go from oxidation # 0 to become positively charged metal ions) with other chemicals (which would get reduced) in an aqueous solution. (See book: top of page 143 or Lecture 11 notes: bottom of page 4)

-Basically, if one metal is higher on the chart than another, the one higher on the table will be the one to react.

-notice that the metals at the bottom of the chart are metals we use to make jewelry, coin, etc. Because they are less reactive, they will last longer.

## Solution Concentrations

-a solution's concentration is analogous to the density of solute (the substance being dissolved) in a certain amount of solvent (the substance doing the dissolving).

-this is expressed as **molarity (M)**

$$M = \frac{\text{mol of solute}}{1\text{L of solution}}$$

-if given two of the following.....

-molarity (concentration of solution)

-moles or grams (amount of solute)

-liters (volume of solution)

.....then you can calculate the third

## Translating word problems:

-What is the concentration..... = What is the **molarity**

-How much solute..... = How many **grams**

-What volume..... = How many **liters** or **mL**

## Using Molarity

-molarity is another ratio that can be used in stoichiometric conversions:

$$\text{volume of solution of A (in L)} \times \frac{\text{mol of A}}{1\text{L}} \times \frac{\text{mol of B}}{\text{mol of A}} \times \frac{\text{molar mass of B (g)}}{\text{mol of B}} = \text{mass of B (g)}$$

  
**Molarity**  
**(mol/L)**

## Sample Problem (TRY THIS)

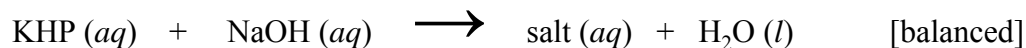
Solid sodium hydroxide absorbs moisture from the air, so it is difficult to weigh accurately to make a solution of known concentration. Potassium hydrogen phthalate, or "KHP"\* (m.w. 204.23), is monoprotic, can be weighed accurately, and is often used to standardize solutions of bases. 0.05182 grams of KHP are placed in a flask beneath a buret filled with NaOH solution of unknown concentration. If 23.4 mL of NaOH solution are required to exactly neutralize the KHP solution, what is the concentration of the NaOH?

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\* Note that "KHP" is an abbreviation, not a chemical formula. The abbreviation comes from K (representing potassium, K), H (representing hydrogen, H), and P (representing phthalate, a large molecule).

Solution: We need to find the concentration or **molarity (M)** of NaOH. Since we already have the volume (23.4mL = 0.0234L), we just need the amount in moles of NaOH. So,

1) Write the acid-base reaction:



2) Next, use the grams and molar mass (or m.w.) of KHP to find the moles of KHP:

$$\frac{0.05182\text{g KHP}}{204.23\text{g/mol}} = 2.537 \times 10^{-4} \text{ mol KHP}$$

3) Use the moles of KHP and coefficients of the acid-base reaction to find moles of NaOH:

$$2.537 \times 10^{-4} \text{ mol KHP} \times \frac{1 \text{ mol NaOH}}{1 \text{ mol KHP}} = 2.537 \times 10^{-4} \text{ mol NaOH}$$

4) Place the grams of NaOH over the volume (**in Liters**) to get **molarity**:

$$\frac{2.537 \times 10^{-4} \text{ mol of NaOH}}{0.0234 \text{ L of NaOH}} = \mathbf{.0109 \text{ M of NaOH}}$$

\*Thursday in class, we start Chapter 5 (**Thermochemistry**) See Lecture 11 slides: page 10 for an outline of this chapter.