Stoichiometry: Predicting Amounts in Reactions *(right page)*

Stoichiometry is the process of determining how much product is made or how much reactant is needed during a chemical reaction. As we know, in chemical reactions atoms **conserved**. We show this in a balanced chemical equation.

The balanced chemical equation tells us two things:

1. **Which substances** we begin with (reactants) and end with (products) during the rearrangement process.
2. The **ratio of particles** involved. This ratio can be seen either as a ratio of individual particles OR as a ratio of moles.

In the lab it is only practical to work with **moles** of substances rather than individual atoms or molecules, and so we interpret our equations as a ratio of moles, or a **mole ratio.**

Example: $\mathbf{2}\ Mg + \mathbf{1}O_2 \rightarrow \mathbf{2}\ MgO$

means for every *2 moles of Mg* burned, *1 mole of O_2* is required to produce *2 moles of MgO*,

or a ratio of ***2** moles Mg : **1** mole O_2 : **2** moles MgO*

We can use this mole ratio relationship to make predictions about how much we need of something, or how much we can make from what we have.

Making Predictions

In every reaction, there are three stages we need to consider to make good predictions:

1. **Before**: What we have before the reaction takes place.
2. **Change**: How much of each substance *actually changes* during the reaction
3. **After**: How much of each substance is present after the reaction is complete.

Some good organization can help us in making good predictions. We have an organizational table that can help us track how many atoms/molecules/moles are present Before, Change, and are present After a reaction. The left page has a sample and some practice problems.

Step 1- Write and Balance the equation (describe the reaction and the mole ratios)

Step 2: Fill in the *Before* line with the Given information; mark what you must Find on the table (with units)

- NOTE: Assume reactants you don't have amounts for are present with more than enough available (**excess**, or "**xs**") for the reaction to be completed.

Step 3: Use the mole ratio (from coefficients) to calculate the *Change* that occurs during the reaction. These are basically dimensional analysis steps. Do calculations beneath your BCA Table.

- NOTE: Reactants are consumed/decrease (-), products accumulate/increase (+)

(left page)

Step 4: Complete the table for what remains *After* the reaction is complete

- NOTE: Find the answer to the problem in the appropriate line of the BCA table.

Sample Problem: Hydrogen sulfide gas (H_2S), which smells like rotten eggs, burns in air to produce sulfur dioxide and water. How many moles of oxygen gas would be needed to completely burn 2.4 moles of hydrogen sulfide?

E**quation**:

Before:

Change

After

- In this case, desired answer is in moles:

- If mass is required for the answer, convert moles to grams in the usual way

$$3.6 \text{ moles } O_2 * \frac{32 \text{ grams}}{1 \text{ mole}} = 115 \text{ grams } O_2$$

Answer (in grams): 115 grams O_2 are needed to burn 2.4 moles H_2S.