

## Stoichiometry

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 are conserved**. We show this in a balanced chemical equation.

**The balanced chemical equation tells us two things:**

1. Reactants and products involved in the chemical change (rearrangement of atoms).
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 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:**  $2 \text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2 \text{MgO(s)}$

For the reaction above, we would interpret the balanced chemical equation as:

For every 2 moles of Mg that reacts, 1 mole of O<sub>2</sub> is required and 2 moles of MgO are produced.

**Thus, the mole ratio is: 2 moles Mg : 1 mole O<sub>2</sub> : 2 moles of MgO**

The mole ratio relationship can be used to make predictions about how much reactant is needed to make a specific amount of product or how much product can be made from the available amount of reactant.

### Making Predictions

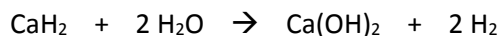
In every reaction, there are three stages to consider:

1. **Before:** amounts of each substance present before the reaction takes place.
2. **Change:** how much of each substance actually changes during the reaction.
3. **After:** amounts of each substance present after the reaction takes place.

These three stages will be organized into a Before-Change-After (BCA) table.

#### Sample Problem 1:

How many moles of H<sub>2</sub> are produced when 0.4 moles of CaH<sub>2</sub> react?

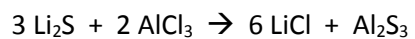


**Before:**

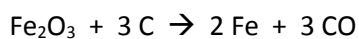
**Change:**

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**After:**

**Sample Problem 2:**

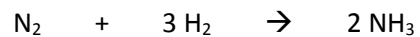
- a) How many moles of LiCl and Al<sub>2</sub>S<sub>3</sub> are made when 6.3 moles of Li<sub>2</sub>S react?
- b) How many moles of LiCl and Al<sub>2</sub>S<sub>3</sub> are produced when 2.2 moles of AlCl<sub>3</sub> react?

**Sample Problem 3:**

- a) How many moles of Fe<sub>2</sub>O<sub>3</sub> and C are required to produce 9.0 moles of CO?
- b) How many moles of Fe are made when 12 moles of C react?

**Sample Problem 4:**

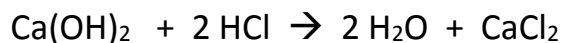
How many grams of NH<sub>3</sub> will be produced when 4.2 moles of H<sub>2</sub> react?



**Summary:**

## Stoichiometry Practice Problems

### Practice Problem 1:



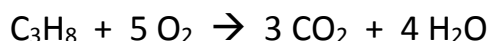
- How many moles of  $\text{Ca(OH)}_2$  are required to react with 6.4 moles of  $\text{HCl}$ ?
- How many moles of  $\text{HCl}$  are required to produce 3.5 moles of  $\text{H}_2\text{O}$ ?
- How many moles of  $\text{Ca(OH)}_2$  are required to produce 12 moles of  $\text{H}_2\text{O}$ ?

### Practice Problem 2:



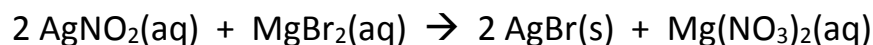
- How many moles of  $\text{O}_2$  are required to produce 8.2 moles of  $\text{H}_2\text{O}$ ?
- How many moles of  $\text{H}_2\text{O}$  are produced when 10.5 moles of  $\text{O}_2$  react?
- How many moles of  $\text{C}_2\text{H}_2$  are required to produce 3.6 moles of  $\text{H}_2\text{O}$ ?
- How many molecules of  $\text{CO}_2$  are produced when 7.4 moles of  $\text{C}_2\text{H}_2$  burn completely in oxygen?

### Practice Problem 3:



- If 12 moles of carbon dioxide are formed, how many moles of  $\text{C}_3\text{H}_8$  (propane) were burned?
- If 2.33 moles of  $\text{C}_3\text{H}_8$  are burned, how many grams of  $\text{CO}_2$  are made?
- How much oxygen is required to react with 3.01 moles of  $\text{C}_3\text{H}_8$ ?
- How many liters of  $\text{CO}_2$  are produced when 4.2 moles of  $\text{C}_3\text{H}_8$  burn in excess  $\text{O}_2$  at STP?

### Practice Problem 4:



- How many moles of  $\text{MgBr}_2$  are required to react completely with 3.55 moles of  $\text{AgNO}_3$ ?
- If 3.13 moles of  $\text{MgBr}_2$  react completely with excess  $\text{AgNO}_3$ , how many grams of  $\text{AgBr}$  are formed?
- To produce 1.98 moles of  $\text{AgBr}$ , how many grams of  $\text{MgBr}_2$  are needed?