

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 O₂ is required and 2 moles of MgO are produced.

Thus, the mole ratio is: 2 moles Mg : 1 mole O₂ : 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

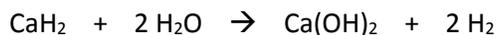
In every reaction, there are three stages to consider:

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:

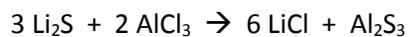
How many moles of H₂ are produced when 0.4 moles of CaH₂ react?



Before:

Change:

After:

Sample Problem 2:

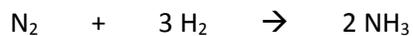
- a) How many moles of LiCl and Al₂S₃ are made when 6.3 moles of Li₂S react?
- b) How many moles of LiCl and Al₂S₃ are produced when 2.2 moles of AlCl₃ react?

Sample Problem 3:

- a) How many moles of Fe₂O₃ 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:

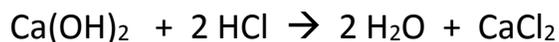
How many grams of NH₃ will be produced when 4.2 moles of H₂ react?



Summary:

Stoichiometry Practice Problems

Practice Problem 1:



- How many moles of Ca(OH)_2 are required to react with 6.4 moles of HCl ?
- How many moles of HCl are required to produce 3.5 moles of H_2O ?
- How many moles of Ca(OH)_2 are required to produce 12 moles of H_2O ?

Practice Problem 2:



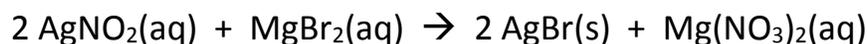
- How many moles of O_2 are required to produce 8.2 moles of H_2O ?
- How many moles of H_2O are produced when 10.5 moles of O_2 react?
- How many moles of C_2H_2 are required to produce 3.6 moles of H_2O ?
- How many molecules of CO_2 are produced when 7.4 moles of C_2H_2 burn completely in oxygen?

Practice Problem 3:



- If 12 moles of carbon dioxide are formed, how many moles of C_3H_8 (propane) were burned?
- If 2.33 moles of C_3H_8 are burned, how many grams of CO_2 are made?
- How much oxygen is required to react with 3.01 moles of C_3H_8 ?
- How many liters of CO_2 are produced when 4.2 moles of C_3H_8 burn in excess O_2 at STP?

Practice Problem 4:



- How many moles of MgBr_2 are required to react completely with 3.55 moles of AgNO_3 ?
- If 3.13 moles of MgBr_2 react completely with excess AgNO_3 , how many grams of AgBr are formed?
- To produce 1.98 moles of AgBr , how many grams of MgBr_2 are needed?