

Limiting Reactant (Limiting Reagent)

Definition

The limiting reactant (or limiting reagent) is the substance that is completely consumed first in a chemical reaction. It determines the amount of product that can be formed. When the limiting reactant is used up, the reaction stops — even if other reactants remain.

Key Idea

In a chemical reaction, the reactants are not always mixed in perfect proportions. The reactant that runs out first limits how much product can be produced. The other reactants that remain are called excess reactants.

Example

Balanced equation: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

According to the equation:

- 2 moles of hydrogen react with 1 mole of oxygen.

If we have:

- 3 moles of H_2

- 2 moles of O_2

To react with all 2 moles of O_2 , we need 4 moles of H_2 , but only 3 are available.

So H_2 will run out first → it is the limiting reactant.

O_2 is the excess reactant.

Law for Calculating the Limiting Reactant

To find the limiting reactant, compare the ratio between the given number of moles of each reactant and the number of moles required according to the balanced chemical equation:

$$\text{Ratio of each reactant} = \frac{\text{Given moles of reactant}}{\text{Moles in the balanced chemical equation}}$$

The reactant that has the smallest ratio is the limiting reactant, because it will be completely consumed first, even if other reactants are still present.

Steps to Identify the Limiting Reactant

- Write the balanced chemical equation.
- Calculate the number of moles of each reactant.
- Find the ratio for each reactant using the formula above.

- The reactant with the smallest ratio is the limiting reactant.
- The other reactant(s) are in excess.

Important Terms

Term

Meaning

Limiting Reactant

The reactant that is used up first and determines how much product forms.

Excess Reactant

The reactant that remains after the reaction ends.