Lecture Notes: Limiting Reactants

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Morehouse College Fall 2017

Determining Limiting Reactant

Limiting Reactant: the reactant that is completely consumed first and which therefore limits the amount of products formed in the reaction.

- Approach 1: Comparing theoretical and real mole ratios.

  - Determine balanced chemical equation
  - Convert all given masses into moles via the molar mass of each ractant
  - Use mole ratio to determine amount needed to fully consume each reactant.
  - Use the amount of limiting reactant to calculate the amount of product produced.

- Approach 2: Compare amounts of product each reactant would produce.

  - Determine balanced chemical equation
  - Convert all given masses into moles via the molar mass of each reactant
  - Use stoichiometry for each reactant to find the mass of product produced
  - The reactant that produces the least amount of product is the limiting reactant.

Problem 1: Using the First Approach:
Nitrogen gas (N_2) can be prepared by passing gaseous ammonia (NH_3) over solid copper oxide (CuO) at high temperatures. The other products of the reaction are solid copper and water vapor. If a sample containing 18.1 g of NH_3 is reacted with 90.4 g of CuO, which is the limiting reactant? How many grams of N_2 will be formed?

Problem 2: Using Both Approaches
The most important commercial process for converting N_2 from the air into nitrogen-containing compounds is based on the reaction of N_2 and H_2 to form ammnia (NH_3):

$$N_2 \, (g) + 3 \, H_2 \, (g) \longrightarrow 2 \, NH_3 \, (g)$$
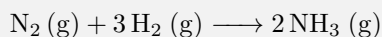
How many moles of NH_3 can be formed from 3.0 mol of N_2, and 6.0 mol of H_2