

9.2: Introduction to Stoichiometry

In chemistry, we often need to calculate the amount of a substance that is either produced from, or needed to react with, a given quantity of another substance.

Define **Stoichiometry**:

Define a **Mole Ratio**:

Ex:

What is the mole ratio between Mg and O₂?

What is the mole ratio between Mg and MgO?

Steps to solve any Stoichiometry problem:

Fill in the map which summarizes the steps for solving a Stoichiometry problem:

9.3: Mole – Mole Calculations

Solving stoichiometric problems where the quantity of starting substance is given in moles and the quantity of desired substance is requested in moles.

Example Problems:

1. How many moles of water can be produced by reacting 0.058 mol of oxygen with hydrogen?
Write the balanced equation here:

2. How many moles of ammonia (NH₃) can be produced from 8.00 mol of hydrogen reacting with nitrogen?
Write the balanced equation here:

3. How many moles of KClO₃ must decompose in order to produce 9.0 moles of oxygen gas?
Write the balanced equation here:

9.4: Mole – Mass Calculations

The object of this type of problem is to calculate the mass of one substance that reacts with or is produced from a given number of moles of another substance in a chemical reaction.

Example Problems:

1. Calculate the number of moles of H_2SO_4 necessary to yield 784 g of H_3PO_4 .

2. Calculate the number of grams of H_2 required to form 12.0 moles of NH_3 .

3. What mass of hydrogen can be produced by reacting 6.0 mol of aluminum with hydrochloric acid?

9.5: Mass – Mass Calculations

In these types of problems, the mass of starting substance is given and the mass of another substance which is produced or needed to produce the product is calculated.

Example Problems:

1. How many grams of silver will be formed from 12.0g copper?

2. Calculate the number of grams of NH_3 formed by the reaction of 112 grams of H_2 .

The quantities of the products we have been calculating from chemical equations represent the maximum yield (100%) of product. However, many reactions fail to give a 100% yield of product mainly because of side reactions and the fact that many reactions are reversible.

- Define **Theoretical Yield:**

- Define **Actual Yield:**

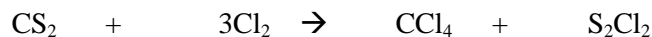
- Give the equation to find the **Percent Yield:**

Steps for solving a percent yield problem:

1. Determine the theoretical yield by calculating the grams of product that can be formed from the given amounts of **each** reactant.
2. Identify the limiting reactant which tells the quantity of product (theoretical yield) that can actually be formed.
3. Calculate the percent yield using the theoretical and actual yields.

Example Problems:

1. Carbon tetrachloride is prepared by reacting 100.g of carbon disulfide and 100.g of chlorine. Calculate the percent yield if 65.0g of CCl₄ was obtained from the following reaction:



2. Aluminum oxide was prepared by heating 225g of chromium (II) oxide with 125g of aluminum. Calculate the percent yield if 100.0g of aluminum oxide were obtained from the following reaction:



Stoichiometry Stuff

Name: _____

Directions: Solve each of the following problems. Show your work, including proper units, to earn full credit.

1. Silver and nitric acid react according to the following balanced equation:



A. How many moles of silver are needed to react with 41.0 moles of nitric acid?

B. From the moles of nitric acid given in Part A, how many grams of silver nitrate will be produced?

2. Given the balanced equation: $2 \text{N}_2\text{H}_4(\text{l}) + \text{N}_2\text{O}_4(\text{l}) \rightarrow 3 \text{N}_2(\text{g}) + 4 \text{H}_2\text{O(g)}$

How many moles of dinitrogen tetrahydride are required to produce 57 grams of nitrogen?

3. Given the unbalanced equation: $\text{___ CaCl}_2 + \text{___ AgNO}_3 \rightarrow \text{___ Ca(NO}_3)_2 + \text{___ AgCl}$

How many grams of silver chloride are produced when 4.5 moles of calcium chloride react with excess silver nitrate?

4. Given the unbalanced equation: $\text{___ NaI} + \text{___ Cl}_2 \rightarrow \text{___ NaCl} + \text{___ I}_2$

How many molecules of iodine are liberated if 54.6 moles of chlorine react?

5. Given the unbalanced equation: $\text{___ Cu} + \text{___ AgNO}_3 \rightarrow \text{___ Cu(NO}_3)_2 + \text{___ Ag}$

How many grams of silver will be produced if 86 grams of copper are used?