CHEM 200

ALL EMAILS SENT TO
CHEM200@SDSU.EDU

OFFICE HOURS HELD VIRTUALLY THROUGH THE MSLC.
TUES 9.00 AM TO 11.00 AM

UPCOMING IMPORTANT DATES

- Pre-Assignment: Qualitative Analysis **Sunday, February 12th at 11:59 pm**
- Achieve Extra Credit: Laboratory Skills **Sunday, February 12th at 11:59 pm**
- Qualitative Analysis Prelab due **Sunday, February 12th at 11:59 pm**
- Volumetric Lab Report due **Sunday, February 12th at 11:59 pm**
- Chapter 1-4 Chapter Problem Sets in OWL Lecture due **Thursday, February 9th at 11:59 pm** (**Start Now**)
- Chapter 1-4 Chapter Assessments in OWL Lecture is **Thursday, February 9th at 11:59 pm** (**Start Now**); 2 chances, no time limit
- Exam 1 starts at **3 pm Friday, February 10th and will close on Saturday, February 11th at 3pm** in OWL Lecture; Chapters 1-4. You have 24hrs. *Only 2 hrs once you start; be sure to give yourself a full 2 hr time slot.*

SUPPLEMENTAL INSTRUCTION (SI)

- Study sessions lead by former CHEM 200/202 students that excelled in the previous semesters class.
- Occur 15+ times a week.
- Free to access, no reporting to faculty.

STOICHIOMETRY

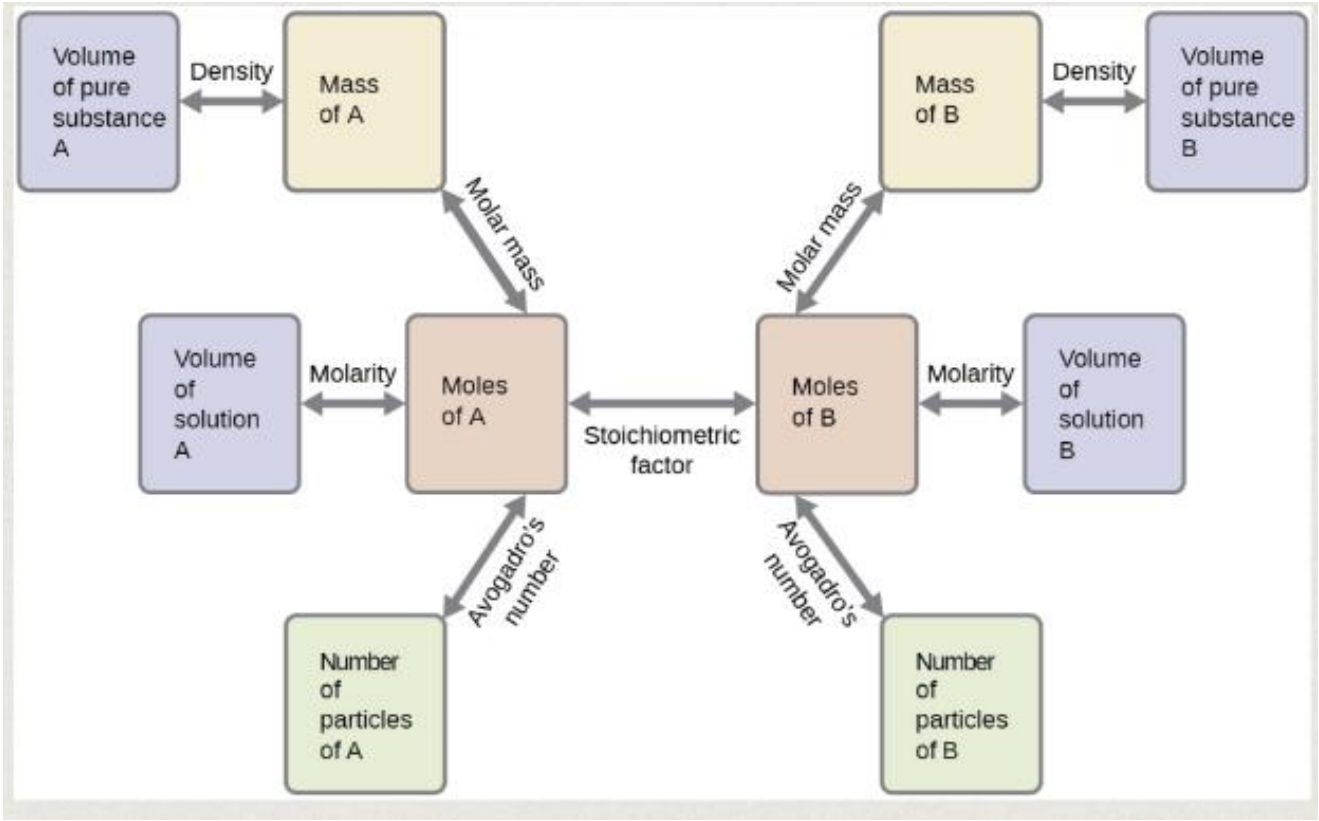
Using Chemical Equations to determine amounts of products and/or reactants that are participating in chemical reactions.

Important to write and balance the chemical equations to determine the mole ratios of the chemical species.

SOLVING STOICHIOMETRY PROBLEMS

1. Write and balance the chemical equation
2. Using the given information, find the number of moles of the known substance
3. Use the mole ratios to find the number of moles of the unknown substance
4. When necessary, convert to grams, particles, etc.

SOLVING STOICHIOMETRY PROBLEMS



STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

1. Write the balanced equation
2. Use the given information to find the number of moles of known substance
3. Use the mole ratio to find the number of moles of unknown
4. Convert number of moles to the desired unit (molecules)
5. Convert number of moles to the desired unit (grams)

STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

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How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

1. Write the balanced equation

$$C_3H_{8(g)} + 5\,O_{2(g)} \rightarrow 3\,CO_{2(g)} + 4\,H_2O_{(g)}$$

STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

2. Use the given information to find the number of moles of known substance

$$88.0\ g\ of\ C_3H_8\left(\frac{1\ mole}{44.10\ g}\right) = 2.00\ moles\ C_3H_8$$

$$C_3H_{8(g)} + 5\,O_{2(g)} \rightarrow 3\,CO_{2(g)} + 4\,H_2O_{(g)}$$

STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

3. Use the mole ratio to find the number of moles of unknown

$$2.00\ moles\ C_3H_8 \left(\frac{3\ mole\ CO_2}{1\ mole\ C_3H_8}\right) = 6.00\ moles\ CO_2$$

STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

4. Convert number of moles to the desired unit (molecules)

$$6.00\ mole\ CO_2 \left(\frac{6.022\ \times 10^{23} molecules}{1\ mole} \right) = 3.61 \times 10^{24}\ molecules\ of\ CO_2$$

STOICHIOMETRY EXAMPLE

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

4. Convert number of moles to the desired unit (grams)

$$6.00\ mole\ CO_2 \left(\frac{44.01\ g}{1\ mole} \right) = 263\ g\ of\ CO_2$$

STOICHIOMETRY EXAMPLE: AS A SINGLE CALCULATION

How many molecules of carbon dioxide are produced when 88.0 g of propane (C_3H_8) undergoes combustion. How many grams of carbon dioxide are produced?

$$88.0\ g\ of\ C_3H_8\left(\frac{1\ mole\ C_3H_8}{44.10\ g}\right)\left(\frac{3\ mole\ CO_2}{1\ mole\ C_3H_8}\right)\left(\frac{6.022\times10^{23} molecules}{1\ mole\ CO_2}\right) = 263\ g\ of\ CO_2$$

$$88.0\ g\ of\ C_3H_8\left(\frac{1\ mole\ C_3H_8}{44.10\ g}\right)\left(\frac{3\ mole\ CO_2}{1\ mole\ C_3H_8}\right)\left(\frac{44.01\ g}{1\ mole\ CO_2}\right) = 3.61\times10^{24}\ molecules\ of\ CO_2$$

FINDING THE LIMITING REACTANT

1. Find the balanced chemical equation
2. Determine how much product can be made with the given amount of each reactant.
3. The reactant that produces the LEAST amount of product is the **limiting reactant**
4. The amount of product calculated from the **Limiting reactant** is the **Theoretical Yield**

LIMITING REACTANT: NON-CHEMICAL EXAMPLE

$$2\ tires + 1\ frame \rightarrow 1\ bicycle$$

How many bicycles can be made with 6 tires and 2 frames?

What is left over?

How many bicycles can be made with 5 tires and 3 frames?

What is left over?

LIMITING REAGENTS: EXAMPLE

How many grams of Carbon dioxide can be produced by the combustion of 132.0 g of propane and 485.0 g of oxygen? What is the mass of water produced? What mass of excess reactant remains?

LIMITING REACTANT EXAMPLE: PHOTOSYNTHESIS

What mass of glucose forms when 2400. g of carbon dioxide reacts with 1800. g of water? What mass of excess reactant remains?

REACTION YIELD

Yield = How much product is formed.

Theoretical Yield = The theoretical amount of product that can be produced based on the given amount of reactants.

Actual Yield = The amount of product that you actually obtain during the experiment.

To determine the theoretical yield, you must determine which reactant is limiting

PERCENT YIELD

Comparing the actual yield to the theoretical yield.

$$percent\ yield = \frac{actual\ yield}{theoretical\ yield} \times 100\%$$

EXAMPLE: THE HABER BOSCH PROCESS

The Haber Bosch process converts nitrogen and hydrogen to ammonia. If 56.0 g of nitrogen and 20.0 g of hydrogen produce 29.5 g of ammonia, determine the percent yield.

EXAMPLE: THE HABER BOSCH PROCESS

How many grams of nitrogen are required to produce 51.0 g of ammonia if the process has a 15% yield?

LIMITING REACTANT EXAMPLE: MAKING CHALK

15.0 mL of 2.0 M Calcium Chloride is mixed with 25.0 mL of 1.5 M Sodium Carbonate. What is the mass of the precipitate?

QUANTITATIVE CHEMICAL ANALYSIS

Determine the amounts or concentrations of chemical species is a sample

Examples:

Titration – determining the concentration of the analyte

Gravimetric analysis – physical change in the analyte allow for its separation from the other chemical components

EXAMPLE: GRAVIMETRIC ANALYSIS

2.0 M silver nitrate was added to a 250.0 mL solution of calcium chloride. The precipitate was collected and dried. The precipitate had a mass of 35.920 g. Determine the concentration of the original calcium chloride solution. What volume of silver nitrate was used?

EXAMPLE

A mixture consisting of only **chromium(II) chloride** ($CrCl_2$) and **copper(II) chloride** ($CuCl_2$) weighs **1.0307** g. When the mixture is dissolved in water and an excess of silver nitrate is added, all the **chloride** ions associated with the original mixture are precipitated as insoluble **silver chloride** (**AgCl**). The mass of the **silver chloride** is found to be **2.2924** g. Calculate the mass percentages of **chromium(II) chloride** and **copper(II) chloride** in the original mixture.

Mass percent $CrCl_2$ = [ ] %

Mass percent $CuCl_2$ = [ ] %