

Chapter 5: Chemical Reactions and Equations

September 26, 2022

Chemistry Department, Cypress College

Class Announcements

Lab Section

- Read the Exp 7: Water in Hydrates Lab
- Bunsen burner to heat the hydrate
- Temperature change is not required observation
- TIP: record all qualitative and quantitative observations

Lecture Section

- All assignments have been graded
- 1.5 hrs Ch. 1 – 4 exam, questions are based on the lectures, homework, and worksheets
- Review Ch. 4 material and begin Ch.5 - Chem Reactions and Equations

Outline

Review: Mass Percent, Moles, and Molarity

Chemical Reactions

Signs of a Chemical Reaction

Writing and Balancing Chem Equations

Predicting Chemical Reactions

Classes of Reactions

Precipitation Rules

Elemental Composition of a Penny



- Penny has not been made of solid copper
- Mix of cheaper metal along with copper on the surface
- Made of 97.5% zinc and 2.5% copper

Different Types of Steel



- Steel is a metal alloy; mixture of different metals yield different physical properties
- Different types:
 - Carbon steel
 - Stainless steel
 - Alloy steel
 - Tool steel

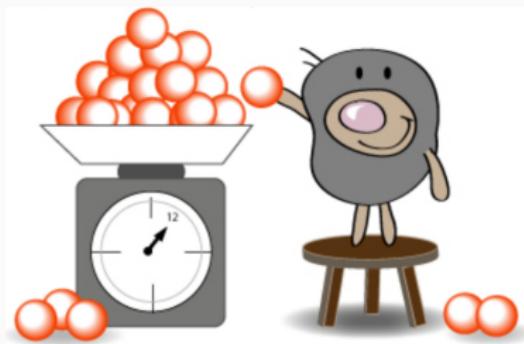
Mass Percent Composition

Main Takeaway: Convert the mass of each component to a percentage of the total mass

$$P_A = \frac{M_A}{M_{\text{Tot}}} \times 100\% \quad (1)$$

where M_{Tot} is the total mass, M_A is the mass and P_A is the percent composition for component A

The Mole Concept

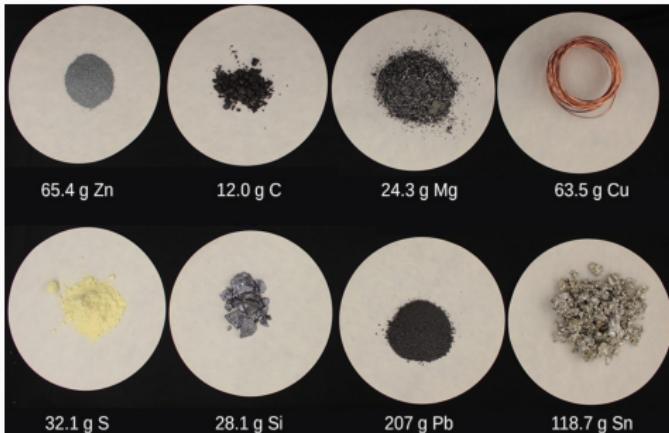


Q: What is a mole (mol)?

A: A mole is measurement of a substance and relates to Avogadro's number (6.022×10^{23} molecules/mol)

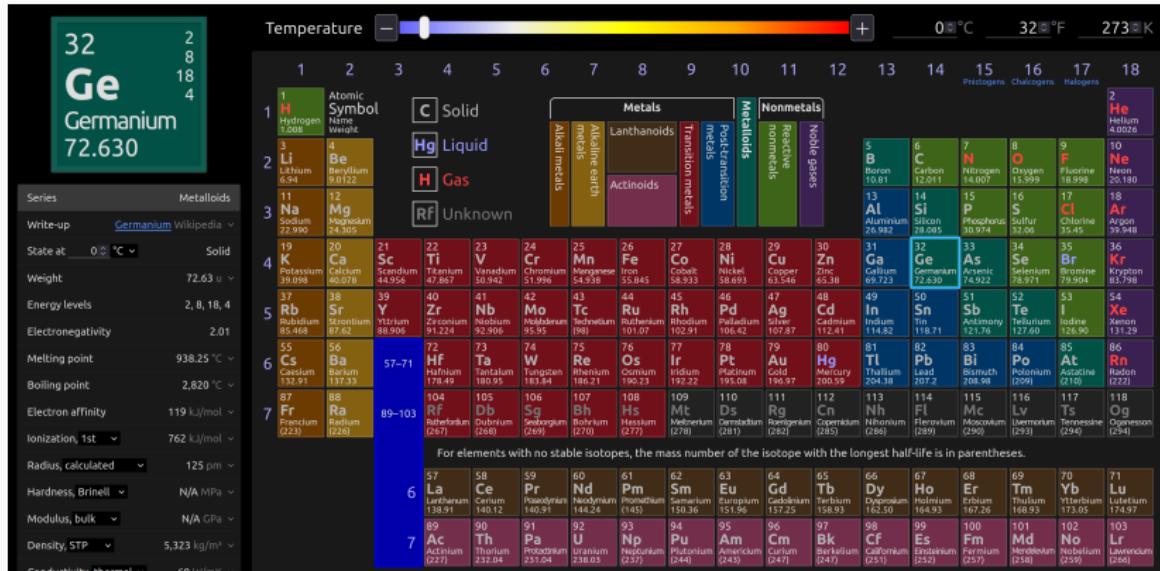
side note: Mole day is Oct. 23, between 6:02 a.m. and 6:02 p.m

Purpose of the Mole



- Gives a consistent method to convert between atoms/molecules and grams
- Convenient way to perform calculations
- View the mole (mol) as a unit conversion type approach

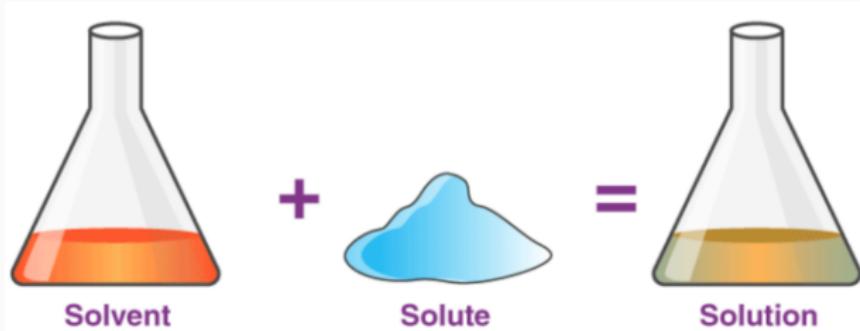
Periodic Table Revisited



Ge - 72.630 amu for 1 atom and the molar mass is 72.630 g/mol

$$1 \text{ amu} = 1.66054 \times 10^{-24} \text{ g}$$

Defn: Solvent and Solute



Solute - a substance (solid, liquid, or gas) dissolved in a solvent

Solvent - the material (liquid or gas) that dissolves the solute

Molarity - Concentration of Solution

Definition of Molarity

$$M = \frac{n_{\text{solute}}}{V} \quad (2)$$

where M is molarity, n_{solute} is the mols of solute, and V is volume in L

Q: What are the units for molarity M ?

Diluting Solutions



Dilution is the process that makes a solution less concentrated.
Example is lemonade tasting too sweet.

Q: For given concentrated solution at molarity M_1 and a given volume V_1 , does diluting the solution to a new concentration M_2 and volume V_2 change the amount of mols present?

Outline

Review: Mass Percent, Moles, and Molarity

Chemical Reactions

Signs of a Chemical Reaction

Writing and Balancing Chem Equations

Predicting Chemical Reactions

Classes of Reactions

Precipitation Rules

Chemistry is Everywhere!

CHEMICAL REACTIONS IN EVERYDAY LIFE



COMBUSTION



RUST



DIGESTION



PHOTOSYNTHESIS



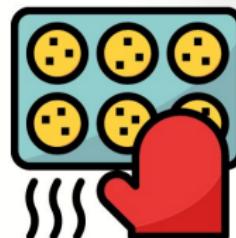
BATTERIES



FERMENTATION



WASHING



BAKING

SCIENCE NOTES.ORG

Defining a Chemical Reaction



- Reactants - chemicals that we start with (A and B)
- Products - chemicals that are formed after (C and D) a reaction

Defining a Chemical Reaction



- Reactants - chemicals that we start with (A and B)
- Products - chemicals that are formed after (C and D) a reaction

Q: Based on Eqn 3, can the reaction go in the reverse e.g. C and D turning into A and B ? Why and why not?

Indications of a Chemical Reaction



- Change in color
- Production of light
- Formation of a solid e.g. precipitate
- Formation of a gas
- Absorption or release of heat

Writing and Balancing Chem Equations

Definitions:

Chemical equation - symbolic representation of a chemical reaction

Balanced equation - draws upon the conservation of mass; the mass of the reactants and the mass of products are equal

Writing and Balancing Chem Equations

Definitions:

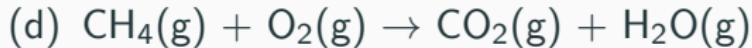
Chemical equation - symbolic representation of a chemical reaction

Balanced equation - draws upon the conservation of mass; the mass of the reactants and the mass of products are equal

Q: Are the moles of reactants and the moles of products the same?

Example: Balancing Chem Equation

Balance the following chemical equations:



Outline

Review: Mass Percent, Moles, and Molarity

Chemical Reactions

Signs of a Chemical Reaction

Writing and Balancing Chem Equations

Predicting Chemical Reactions

Classes of Reactions

Precipitation Rules

Classes of Reactions

Class	Reactants	Products	Example
Decomposition	1 compound	multiple	$CD \rightarrow C + D$
Combination	multiple	1 compound	$A + D \rightarrow AD$
Single-displacement	elem+comp	elem+comp	$A + CD \rightarrow C + AD$
Double-displacement	2 compounds	2 compounds	$AB + CD \rightarrow AD + BC$

Decomposition Reactions

Combination Reaction

Single-Displacement Reaction

Double-Displacement Reaction

Example: Chemical Reaction Classifications

Memorize: Precipitation Rules

Example: