Today's Lecture

- ✓Announcements
- ✓Quizzes
- ✓Stoichiometry
  - – Avogadro's Number and Mole

Announcements

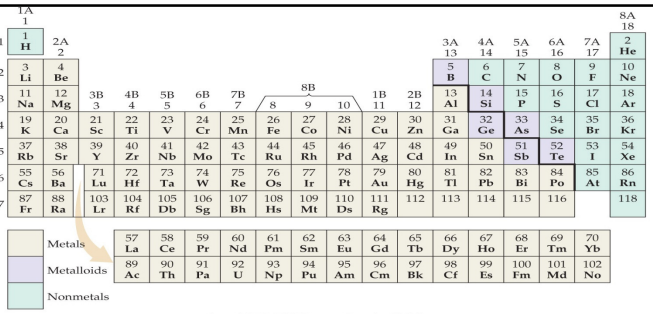
- Office hours
  - – Mon, Wed, 11:30-12:30 am
  - – Sun,Tue,Thu 11:00-12:00 pm
- Reading
  - – Chapter 3, Sections **(3.4**),(3.6) and (3.7)
- Suggested Problems
- 3.27,3.293.31,3.33, 3.35, 3.37,3.39,3.41,3.573.59, 3.61, 3.63,3.67,3.69, 3.71,3.73,3.77

The nucleus of an atom contains:

a. protons and neutrons.
b. protons and electrons.
c. electrons and neutrons.
d. air.

Atoms with identical atomic numbers but different mass numbers are called:

a. mutants.
b. isomers.
c. isotopes.
d. symbiots.



Atoms of elements on the left side of the periodic table tend to:

a. gain electrons.
b. lose electrons.
c. keep electrons.
d. share electrons.

Matter And Measurement

A compound consisting of a metal and a nonmetal is called:

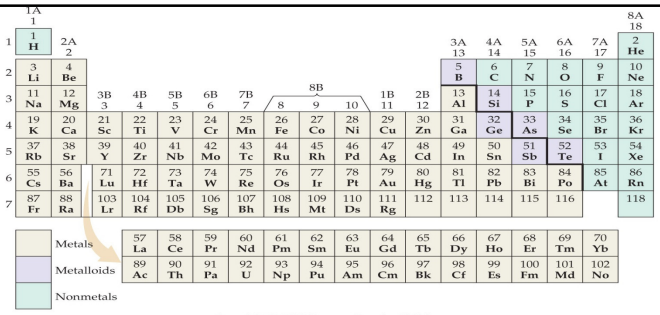
a. a molecular compound.
b. a mixed compound.
c. an empirical compound.
d. an ionic compound.

Matter And Measurement

Positive ions are called:

a. positrons.
b. anions.
c. cations.
d. nucleons.

Matter And Measurement



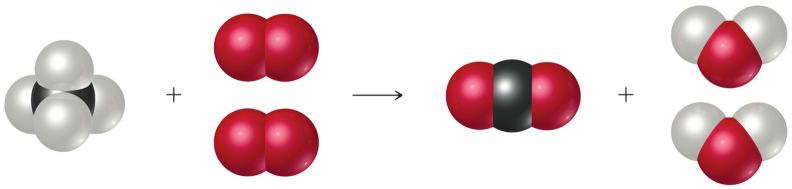
The elements located in group 7A of the periodic table are called:

a. alkali metals.
b. noble gases.
c. chalcogens.
d. halogens.

Matter And Measurement

Anatomy of a Chemical Equation

$$CH_{4\,(g)} + 2\,O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2\,H_2O_{\,(g)}$$

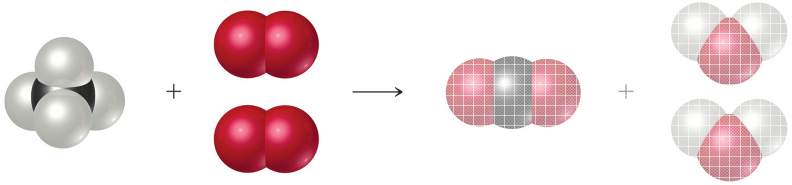


$\binom{1\,C}{4\,H}$ $(4\,O)$ $\binom{1\,C}{2\,O}$ $\binom{2\,O}{4\,H}$

Matter And Measurement

Anatomy of a Chemical Equation

$$CH_{4\,(g)} + 2\,O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2\,H_2O_{\,(g)}$$



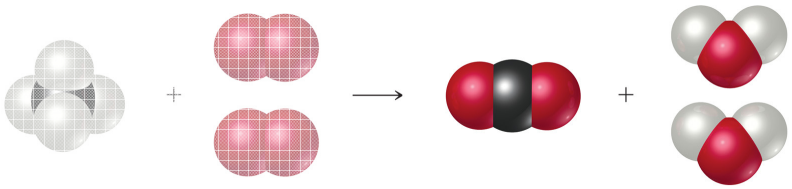
$\binom{1\,C}{4\,H}$ $(4\,O)$ $\binom{1\,C}{2\,O}$ $\binom{2\,O}{4\,H}$

Reactants appear on the left side of the equation.

Matter And Measurement

Anatomy of a Chemical Equation

$$CH_{4\,(g)} + 2\,O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2\,H_2O_{\,(g)}$$



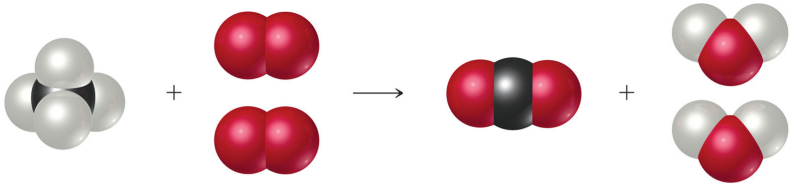
$\begin{pmatrix}1\,C\\4\,H\end{pmatrix}$ $(4\,O)$ $\begin{pmatrix}1\,C\\2\,O\end{pmatrix}$ $\begin{pmatrix}2\,O\\4\,H\end{pmatrix}$

Products appear on the right side of the equation.

Matter And Measurement

Anatomy of a Chemical Equation

$$CH_{4\,(g)} + 2\,O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2\,H_2O_{\,(g)}$$



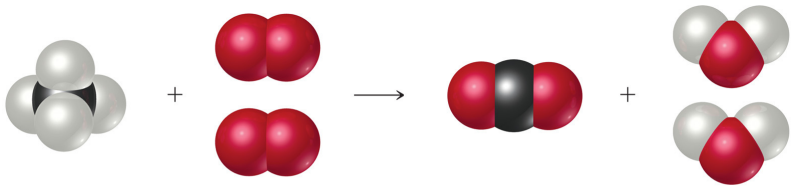
$\begin{pmatrix}1\,C\\4\,H\end{pmatrix}$ $(4\,O)$ $\begin{pmatrix}1\,C\\2\,O\end{pmatrix}$ $\begin{pmatrix}2\,O\\4\,H\end{pmatrix}$

The states of the reactants and products are written in parentheses to the right of each compound.

Matter And Measurement

Anatomy of a Chemical Equation

$$CH_{4\,(g)} + 2\,O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2\,H_2O_{\,(g)}$$

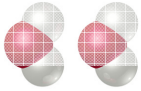


$\begin{pmatrix}1\,C\\4\,H\end{pmatrix}$ $(4\,O)$ $\begin{pmatrix}1\,C\\2\,O\end{pmatrix}$ $\begin{pmatrix}2\,O\\4\,H\end{pmatrix}$

Coefficients are inserted to balance the equation.

Matter And Measurement

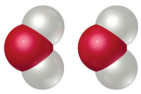
Subscripts and Coefficients Give Different Information

Chemical symbol	Meaning		Composition
H_2O	One molecule of water:		Two H atoms and one O atom
$2\,H_2O$	Two molecules of water:		Four H atoms and two O atoms

- Subscripts tell the number of atoms of each element in a molecule.

Matter And Measurement

Subscripts and Coefficients Give Different Information

Chemical symbol	Meaning		Composition
H_2O	One molecule of water:		Two H atoms and one O atom
$2\ H_2O$	Two molecules of water:		Four H atoms and two O atoms

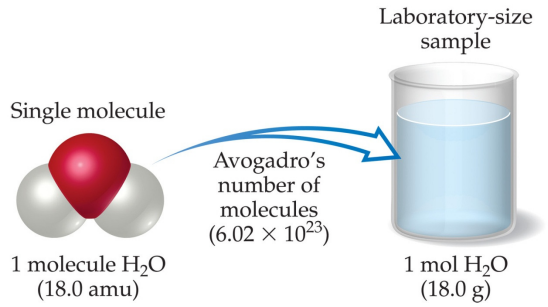
- Subscripts tell the number of atoms of each element in a molecule
- Coefficients tell the number of molecules.

Matter And Measurement

Moles

Matter And Measurement

Avogadro's Number



- 6.02×10^{23}
- 1 mole of ^{12}C has a mass of 12 g.

Matter And Measurement

Molar Mass

- By definition, a molar mass is the mass of 1 mol of a substance (i.e., g/mol).
  - The molar mass of an element is the mass number for the element that we find on the periodic table.
  - The formula weight (in amu's) will be the same number as the molar mass (in g/mol).

Matter And Measurement

Using Moles

Moles provide a bridge from the molecular scale to the real-world scale.

Mole Relationships

Name of Substance	Formula	Formula Weight (amu)	Molar Mass (g/mol)	Number and Kind of Particles in One Mole
Atomic nitrogen	N	14.0	14.0	6.02×10^{23} N atoms
Molecular nitrogen	N_2	28.0	28.0	6.02×10^{23} N_2 molecules $2(6.02 \times 10^{23})$ N atoms
Silver	Ag	107.9	107.9	6.02×10^{23} Ag atoms
Silver ions	Ag^+	107.9[a]	107.9	6.02×10^{23} Ag^+ ions
Barium chloride	$BaCl_2$	208.2	208.2	6.02×10^{23} $BaCl_2$ units 6.02×10^{23} Ba^{2+} ions $2(6.02 \times 10^{23})$ Cl^- ions

[a]Recall that the electron has negligible mass; thus, ions and atoms have essentially the same mass.

- One mole of atoms, ions, or molecules contains Avogadro's number of those particles.
- One mole of molecules or formula units contains Avogadro's number times the number of atoms or ions of each element in the compound.

Sample Exercise 3.7 Estimating Numbers in Atoms

Without using a calculator, arrange the following samples in order of increasing numbers of carbon atoms: 12 g ^{12}C, 1 mol C_2H_2, 9×10^{23} molecules of CO_2.

Practice Exercise

Without using a calculator, arrange the following samples in order of increasing number of O atoms: 1 mol H_2O, 1 mol CO_2, 3×10^{23} molecules O_3.

Sample Exercise 3.8 Converting Moles to Atoms

Calculate the number of H atoms in 0.350 mol of $C_6H_{12}O_6$.

Practice Exercise

Calculate the number of H atoms in 0.350 mol of $C_6H_{12}O_6$.

Sample Exercise 3.9 Calculating Molar Mass

What is the mass in grams of 1.000 mol of glucose, $C_6H_{12}O_6$?

Practice Exercise

Calculate the molar mass of $Ca(NO_3)_2$.

Next Lecture

- Stoichiometry
  - Chapter 3
    - Quantitative Information from balanced Equation
    - Section 3.6