Chapter 7 – Chemical Quantities
Part 1 – Notes: Mole Calculations

Objectives: Identify, define, and explain: mole, Avogadro's number, representative particle, gram atomic mass, gram molecular mass, gram formula mass, molar mass, standard temperature and pressure, and molar volume.
Describe how Avogadro's number is related to a mole of any substance.
Calculate the mass of a mole of any substance.
Convert between various units: mass, volume at STP, molecules, atoms of a specific element in a compound, and mole, using unit analysis.
Text Reference: Section 7.1 (pages 171-181) and Section 7.2 (pages 182-186)

Start-up Problem: We go to the store to buy apples. We know that the medium-sized apples we wish to buy have a mass of 2.0-kg per dozen apples. What would be the mass of the 90 apples we wish to purchase? We need to use unit analysis!!!

Previously you learned that matter is composed of different component particles. One method of measuring a substance is to count the number of component particles in the substance but since atoms, ion, and molecules are very small, counting them is very impractical. So we introduce a unit that allows us to count large quantities of component particles. Due to the size of atoms, ions, and molecules, this unit will need to account for a LARGE number of component particles. Let's begin exploring the ***MOLE***.

The ***MOLE*** is unit used to count large numbers of representative particles in compounds. The number associated with the mole was experimentally determined.

The experimentally determined number is 6.02×10^{23}. This number is known as ***Avogadro's number.***

Officially, the number of particle present in **1 mole** of a substance is equal to the number of carbon-12 atoms in exactly 12 grams of a sample of carbon-12. Since it is a number, it can also be applied to other substances with various representative particles.

Representative particle: the smallest unit into which a substance may be broken down without a change in composition; it refers to the component particles of various types of substance: atoms, ions, or molecules.

The representative particle of an element is an atom. Remember that there are **seven** elements which exist as **diatomic elements** in their free (uncombined) state. These elements are:

Let's solve some problems using our new-found **mole knowledge**:

TYPE I: You know that the mole relationship can be used to determine the number of atoms or molecules in a given number of moles and vice versa:

MOLES ↔ ATOMS of an element

MOLES ↔ MOLECULES or FORMULA UNITS of a compound

Example 1: How many atoms of calcium are present in 5.376 moles of calcium?

TYPE II: You know that since a mole is a specified number of objects and you can take the mass of a specified number of things, then a mole of things has a certain mass. You use the PERIODIC TABLE to determine the mass of a given element. You can use the relationship between mole and mass from the periodic table to perform the following calculations:

MOLE ↔ MASS (grams) OF AN ELEMENT

Example 2: How many moles of copper are present in a sample of copper that has a mass of 213.025 g?