

Intro to the Mole

Atomic and Molar Masses
Chemistry 11



Atomic Masses:

- Each element has a different mass
 - vary based on the number of sub-atomic particles present
- The mass of one atom is VERY small so it has a special unit used to describe it...
 - **amu** – **atomic mass unit (or u)**
- The masses of all elements are compared on a relative scale – always compared to the mass of carbon-12
 - 1amu = 1/12 of the mass of carbon-12

What is the Atomic Mass?

- The average mass of an atom of a particular element
- Found on the periodic table
 - Ex. Atomic mass of Lithium = 6.9amu
 - Magnesium = ?
- Why an average?
 - There are different isotopes, so some atoms of the same element weigh slightly different amounts (we will come back to this concept)

Molecular Mass:



- Just like atomic mass, but for an entire molecule
 - Still reported in amu!
 - Example:
 - Find the molecular mass of H_2SO_4
 - $\text{H} : 2 \times 1.0 = 2.0$
 - $\text{S} : 1 \times 32.1 = 32.1$
 - $\text{O} : 4 \times 16.0 = 64.0$
- 98.1amu

The Mole: (not the animal)

- What do we call 12 eggs?
- 12 cookies?
- 12 cans of pop?
- All of these show us that 12 = 1 dozen
- The mole (mol) is kind of like a dozen but much larger
- The mole is based on the number of atoms in 12.0g of carbon-12



The Mole Cont.

- For any element, 1 mole of atoms has the mass (in grams) numerically equal to the atomic mass
 - Examples
 - 1 mole of lithium atoms = 6.9g
 - 1 mole of lead atoms = 207.2g
 - 1 mole of gold atoms = 197.0g
- In all of these amounts there are...
 - 6.022 x 10²³ atoms
- If you have 1 mole of ANYTHING, you have 6.022x10²³ of that object (just like 1 dozen = 12)



How Big is a Mole?

- VERY big!!!
 - If you won a mole of dollars in the lottery that would be equal to:
- \$602 200 000 000 000 000 000 000.00**



← A lot of this!

Why do we need the Mole?

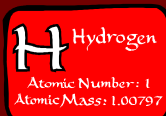
- Amadeo Avogadro came up with the concept to relate mass of an element (in grams) to the number of atoms
 - Relating the macroscopic to microscopic
- The **MOLAR MASS** is the mass of one mole of a substance
- The molar mass is equal to the atomic mass, but expressed in grams per mole (g/mol)



Examples:



- 1 **atom** of aluminum = 27.0amu
- 1 **mole** of aluminum = 27.0 g
∴ the molar mass of aluminum = 27.0 g/mol
- 1 **molecule** of hydrogen (H₂) = 2.0amu
- 1 **mole** of hydrogen = 2.0g
∴ the molar mass of hydrogen = 2.0 g/mol



Note: in this class, we will only use molar masses to ONE decimal place

Examples to Try:

Find the molar mass of each of the following:

- NH₃ = ?
- HCl = ?
- KMnO₄ = ?
- Ca(CH₃COO)₂ = ?

Examples to Try:

Find the molar mass of each of the following:

- NH₃ = N : 1 x 14.0 = 14.0
H : 3 x 1.0 = 3.0
17.0 g/mol
- HCl = ?
- KMnO₄ = ?
- Ca(CH₃COO)₂ = ?