Molecular Weight

Just like atoms, molecules are too small to weigh on a scale and too small to deal with in the real world. Instead, we will use a mole of molecules.

Just like **atomic weight can** be determined from the periodic table, **molecular weight** can too.

- Molecular weight = the weight of the molecule (g/mole)
- Atomic weight = the weight of the atom (g/mole)

- Molecular weight (also called Formula weight) is equal to the sum of the atomic weights of all the atoms in the formula
  - Example: NaCl
    - Atomic weight of Na = 22.99 g/mol
    - Atomic weight of Cl = 35.45 g/mol
    - Molecular weight of NaCl = 58.44 g/mol
  - Example: $FeCl_2$
    - Fe = 55.847 g/mol
    - Cl = 35.45 g/mol
    - $FeCl_2$ = 55.847 + 2(35.45) = 126.75 g/mol
  - Example: $NaHCO_3$
    - Na = 22.99 g/mol
    - H = 1.008 g/mol
    - C = 12.011 g/mol
    - O = 15.9994 g/mol
    - $NaHCO_3$ = 22.99 + 1.008 + 12.001 + 3(15.9994) = 84.01 g/mol
  - Example: $Ca(OH)_2$
    - Ca = 40.078 g/mol
    - O = 15.9994 g/mol
    - H = 1.008 g/mol
    - $Ca(OH)_2$ = 40.078 + 2(15.9994 + 1.008) = 74.082 g/mol

- The molecular weight tells how much one mole of molecules weigh.
  - How much does one mole of NaCl weigh?
    - 58.44 g/mol
  - How much does two moles of NaCl weight?
    - 2 * 58.44 g/mol = 116.88 g/mol
  - How many molecules of NaCl in one mole?
    - 6.022×10^{23}
  - How many atoms of Na in one mole of NaCl?
    - 6.022×10^{23}
  - How many atoms in NaCl?
    - 2 kinds of atoms x number of atoms in one mole

        - $2 * 6.022 \times 10^{23} = 1.2 \times 10^{24}$
    - How many atoms in one mole of $NaHCO_3$
        - 4 kinds of atoms x number of atoms in one mole
        - $4 * 6.022 \times 10^{23} = 4.8 \times 10^{24}$
    - How many moles in 148.2 g of $Ca(OH)_2$?
        - 148.3 g / 74.08g/mol = 2 mol

Percent composition

It is useful to calculate the percentage of mass that comes from a particular element.

Say you are mining for copper, for every pound that you mine, how much copper will you get? If you knew that for every pound, you would get 0.5 lb of copper than you could say that the ore is 50% copper by mass.

Percent composition tells you how much of the mass is made up by each element.

$$\text{Percent Composition} = \frac{\text{Mass of Element}}{\text{Mass of Compound}} \text{ X } 100$$

Example: What is the percent composition of NaCl?

- Percent composition of Na in NaCl
    - 22.99 g / 58.44 g = .39 → 39% Na
- Percent comp of Cl?
    - 35.45 g/ 58.44 g = .61 → 61% Cl
- 61% + 39% = 100%

Hydrates

- Some ionic compounds can absorb water molecules.
  - **Anhydrous** = no water absorbed
  - **Hydrate** = water absorbed
- The water molecules fit between the cations an anions in the **crystal lattice**
- The kind of crystal structure determines how many water molecules can be absorbed.
- The more water molecules that can be absorbed – the better **desiccant** the compound makes.
  - Desiccant is the name for chemicals that absorb water
    - Antiperspirants use desiccants
    - Silica gel (those little packets you find in your shoe box, new purses) is a desiccant. It's also used to dry flowers so that they look fresh.
- Formula for Hydrates =
  - Chemical formula • number of water molecules
  - $Cu_2SO_4 \bullet 5H_2O$
  - Name: copper (II) sulfate pentahydrate
  - Prefixes:
    - Mono = 1
    - Di = 2
    - Tri = 3
    - Tetra = 4
    - Penta = 5
    - Hexa = 6
    - Hepta = 7
    - Octa = 8
    - Nona = 9
    - Deca = 10