Chapter 3 – Mass Relationships

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September 10, 2020

- Molar Mass
  1. $6.022 \cdot 10^2 3$ is one mole (Avogadro's number)
  2. Obtained by adding the atomic mass of each element present
  3. ex. C = 12[g]/mol
- Molarity (M)
  1. mol/L
- Molar Ratio
  1. Use $C_1 2H_2 2O_1 1$ for example:
  2. Ratio for Carbon: $\frac{12\text{mol}_C}{\text{mol}_{C_{12}H_{22}O_{11}}}$
  3. Ratio for Hydrogen: $\frac{22\text{mol}_H}{\text{mol}_{C_{12}H_{22}O_{11}}}$
  4. Ratio for Oxygen: $\frac{11\text{mol}_C}{\text{mol}_{C_{12}H_{22}O_{11}}}$
- Mass Percent
  1. Mass of Element per Mass of Compound times 100 ($\frac{m_e}{m_c} \cdot 100$)
- Chemical Formulas:
  1. Empirical Formula – The simplest form, only gives the ratios of atoms
  2. Molecular Formula – The actual formula, gives the exact ratio of atoms (sometimes Molecular can be Empirical, but usually not)
- Calculating the Empirical Formula:
  1. Convert to Moles

2. Divide all by the smallest
3. Multiply by integer

- Combustion Reactions:

1. Always involves a hydrocarbon (anything involving CH)
2. Ex (simplest reaction):

$$CH + O_2 \rightarrow H_2O + CO_2$$

- Balancing Equations:

1. $N_2H_4 + N_2O_4 \rightarrow N_2 + H_2O$

$$N_2H_4 + N_2O_4 \rightarrow N_2 + 4H_2O$$
$$2N_2H_4 + N_2O_4 \rightarrow N_2 + 4H_2O$$
$$2N_2H_4 + N_2O_4 \rightarrow 3N_2 + 4(H_2O)$$

2. $NH_3 + O_2 \rightarrow NO + H_2O$

$$2NH_3 + O_2 \rightarrow NO + 3H_2O$$

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

- What is the Difference? One is three unbound nitrate molecules, while the other is three chemically bound nitrate molecules

$$3NO_3 \text{ vs } (NO_3)_3$$

- Stoichiometry $-$ Calculations with balanced equations
- Combust C_3H_8:

1. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
2. Start with 17.8[g] of O_2, how much H_2O do we have at the end?

$$\frac{17.8}{32} = .556[\text{mol}] \cdot \frac{4}{5} = .445[\text{mol}] \cdot 18\frac{[\text{g}]}{[\text{mol}]} = 8[\text{g}]\ H_2O$$