Chapters 5 → Chemical Reactions

Properties of Gases

- Fill any container
- Easily compressible

Barometer

- Measures atomic pressure
    - Weight of air
- Glass tube filled with mercury

Units

- $mm\ Hg = torr$
- $1\ atm = 101.325\ Pa$
- $1\ standard\ atmosphere = 1\ atm = 760\ mm\ Hg = 760\ torr$

Kinetic Molecular Theory

- Explains properties of ideal gasses
- Rules
    A) Distance between particles in negligible
    B) Particles are in constant motion
        ❖ Pressure is caused by collision
    C) Particles exert *no* force on each other
        ❖ Don't attract nor repel each other
    D) Average kinetic energy of gas particles is assumed to be proportional to Kelvin
        ❖ During particle collisions, there is an exchange of kinetic energy

Ideal Gas Behavior

- Low temperature, high pressure
- H_2 and He are the most ideal due to low mass and weak intermolecular forces (IMF)

Gas Relationships

- $PV = nRT$
    - $P \propto K$
    - $K \propto V$
    - $P \propto \frac{1}{V}$ **or** $\frac{1}{P} \propto V$
    - $V \propto n$
    - $V_{gas} \propto n_{gas}$

Avagadro's Law

- Equal volumes of gases held at constant temperature and pressure contain equal number of moles and molecules of gas

Ideal Gas Law

- $PV = nRT$
  - State of gas at a given time
  - If gas obeys the law, it is ideal
  - Universal gas constant, R, is listed in the reference table
- $MM = \frac{dRT}{P}$
  - Must memorize!!
  - Can also be written as…
    - $MM = \frac{\frac{m}{V}RT}{P}$
    - Since $density = \frac{mass}{volume}$

Partial Pressure

- Pressure of a gas when exerted alone
- $P_{total} = \Sigma P'$
  - Total pressure is equal to the sum of all partial pressure
  - $P_{total} = P_1 + P_2 + P_2 + \ldots$
- According to kinetic molecular theory, all gas particles are independent
  - Volume is not important

Mole Fraction

- $x_1 = \frac{n_1}{n_{total}} = \frac{P_1}{P_{total}}$
- Moles are proportional to pressure
  - $n \propto P$

Vapor (water) Pressure

- Numbe of vapor molecules stay constant
- Pressure is constant

Temperature

- Kelvin represents the average kinetic energy of a gas
- $KE_{average} = \frac{3}{2}RT$
  - Shows relationship between temperature and average kinetic energy
  - $= \sqrt{\frac{3RT}{m}}$
    - Unit is in Urms

Effusion and Diffusion

- Diffusion
    - Mixing of gasses
- Effusion
    - Passage of gasses through an orifice into an evacuated chamber
    - Grahm's Law of Effusion
        - $\frac{rate\ of\ effusion\ of\ gas_1}{rate\ of\ effusion\ of\ gas_2} = \sqrt{\frac{M_2}{M_1}}$

Other Formulas

- $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
- $PV = nRT$
- $\frac{v_1}{n_1} = \frac{v_2}{n_2}$
- $MM = \frac{dRT}{P}$
- $d = \frac{MMP}{RT}$
- $P_1V_1 = P_2V_2$
- $P_{total} = P_1 + P_2 + P_3 + \ldots$