Chapter 5 – Gases

Michael Brodskiy
Instructor: Mr. Morgan

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- Gases – Uniformly fill any container; Easily compressed; Mixes completely with other gases; Exert pressure.
- Units: [atm] = 60[mmHg] = 760[torr] = 14.69[psi] = 1.013[bar] = 101325[Pa]
- Boyle's Law – Pressure and volume are inversely related
- Charles's Law – Volume directly proportional to temperature
- Avogadro's Law – Volume directly proportional to moles
- Ideal Gas Law: $PV = nRT$; $R = .0821 \left[\frac{\text{L ATM}}{\text{mol K}}\right]$
- Standard Temperature and Pressure (STP) – 273[K] and 1[ATM]
- At STP, one mole of a gas occupies 22.4[L]
- Note: Hydrogen, Nitrogen, Oxygen, and Halogens are diatomics
- Gay-Lussac Law – The volume ratio of any two gasses in a reaction at constant pressure and temperature is equal to the mole ratios
- The above law means that the type of molecule does not matter, only the amount of molecules. When asked for partial pressure, it may be found using the equation (1)

$$P_{total} = P_a + P_b + \cdots + P_n \tag{1}$$

- When asked for the mole fraction, use formula (2), where x_a is the mole fraction.

$$P_a = x_a P_{total} \tag{2}$$

- Kinetic Molecular Theory – Gases are made of small particles in constant, random motion. Collisions with wall cause pressure. Kinetic energy is directly proportional to temperature. If Temperature then average speed pressure , etc.

- Speed – $U = \left(\frac{3RT}{M}\right)^{\frac{1}{2}}$
- Effusion – Flow of gas particles through tiny hole. Smaller molar mass particles effuse faster. Graham's Law.
- $\frac{U_b}{U_a} = \left(\sqrt{\frac{m_{molar_a}}{m_{molar_b}}}\right)$

$$m_{molar} = \frac{g}{V} \cdot \frac{RT}{P} \tag{3}$$

- Non-Ideal Conditions – At these conditions, gases act less ideal:
    1. Low Temperatures – Particles slow down, attractive forces take over. Observed volume is less than calculated.
    2. High Pressures – Particles are pushed together, attractive forces take over. Observed volume is less than calculated.
    3. Very High Pressures – Size of particles prevent volume from getting smaller. Observed volume is greater than calculated.