

## Chapter 5: Gases

### Properties of Gases:

- 1) Gases fill their containers completely (unlike liquids).
- 2) Gases occupy far more space than liquids or solids because their molecules have a large amount of space between them.
- 3) Gases are compressible.

### Kinetic Molecular Theory:

- 1) All molecules are in constant motion.
- 2) Molecules keep traveling in straight line until they collide with another and change course (this is the reason molecules are considered elastic).
- 3) Molecules collide with other molecules in an elastic collision so there is no net gain or loss of energy.
- 4) There is always some empty space between particles so no container is completely packed with gas molecules.
- 5) The kinetic energy of the molecules depend on the temperature; so warm gas molecules move faster than colder gases.

### Pressure:

Force/unit area , units: Pascal, atmosphere, torr, mmHg, newtons (SI unit)

Measuring atmospheric pressure: barometer, using mercury.

760 mmHg = 1 atm = 760 torr = 101.325 kPa = 14.696 psi

manometer: measuring gas pressures.

### Gas Laws:

Boyle's Law	P inversely proportional to V	PV = constant	$P_1V_1 = P_2V_2$
Charles's Law	P directly proportional to T	V = T • constant	$V_1/T_1 = V_2/T_2$
Avogadro's Law	V directly proportional to n at constant P and T	V = n • constant	$V_1/n_1 = V_2/n_2$
Dalton's Law	Total pressure of mixture of gases is equal to the partial pressures of all the gases in the system.		$P_{\text{total}} = P_1 + P_2 + P_3 + \dots$

Temperature is always measured in Kelvin ( $0^\circ\text{C} = 273.15\text{ K}$ )

STP conditions: T = 273.15 K and P = 1 atm, n = 1 mol, V = 22.4 L

Combined Gas Law	$P_1V_1/n_1T_1 = P_2V_2/n_2T_2$
Ideal Gas Law	PV = nRT (R = gas constant = 0.082058 L atm/mol K) (Values of R changes with different units)
Gas Density	d = MP/RT (M = molar mass)

### Key Concepts and Words:

Manometer	Kinetic Molecular Theory	The Laws: Boyle's, Charles's, Avogadro's, Combined Gas Law, Ideal Gas Law, Gay-Lussac's, Dalton's.
Molar Gas Constant	Standard Pressure, Temperature and Volume	Diffusion and Effusion
Real Gas	Gas Stoichiometry	Collecting gas over water