CHAPTER 5: GASES

Gases → Assume the volume of a container
→ Most compressible state of matter
→ Mix completely and evenly in some container
→ Much lower density than solids or liquids

* PARTICLES ARE FAR APART FROM EACH OTHER*

\[ F = \frac{k \cdot q_1 q_2}{r^2} \]

\[ k \cdot q_1 q_2 = 0 \]

\[ k \cdot q_1 q_2 = 0 \rightarrow \text{“ideal gas”} \]

Pressure = \frac{force}{area}

"Standard" p = 760 mm-Hg

760 torr
1 atm
101.3 kPa

KINETIC MOLECULAR THEORY

1. A gas is composed of particles (atoms, molecules, etc...) that are very far apart relative to their own size
   → "point volumes" with mass

2. Gas particles are in constant, random straight line motion (Brownian)
   → Constant elastic collisions
   \( \Delta E \leq 1 \)
CHAPTER 5 GASES

Gases → assume the volume of a container → most compressible state of matter
→ mix completely and evenly in same container → much lower density than solids or liquids

* PARTICLES ARE FAR APART FROM EACH OTHER *

\[ F = \frac{kQ_1Q_2}{r^2} \]

\[
\text{IMF's} = 0 \\
\text{IMF} = 0 \rightarrow \text{“ideal gas”}
\]

Pressure = \frac{\text{force}}{\text{area}}

“standard” \( P = 760 \text{ mmHg} \)

760 torr

1 atm

101.3 kPa

KINETIC MOLECULAR THEORY

1. A gas is composed of particles (atoms, molecules, etc...) that are very far apart relative to their own size

   → “point volumes” with mass

2. Gas particles are in constant, random, straight line motion (Brownian)

   → constant elastic collisions → no E lost
3. Gas particles are not attracted to or repelled by each other (no IMF's).

4. The average KE is proportional to the absolute (KELVIN) temperature of the gas:

\[ KE = \frac{1}{2} m v^2 \quad \langle K = \frac{3}{2} R T \quad ^o C = K - 273 \rangle \]

5. Gas P is due to collisions between the particles of the gas and the walls of the container, depends on frequency and force of collisions.

---

**IDEAL GAS**

**Avogadro's Hypothesis**

At constant T and P, the volume of a gas is directly proportional to the number of moles present:

\[ V \propto n \quad \text{if T, P are constant} \]

* in a balanced eqn. where everything is a gas, coefficients can represent VOLUMES

\[ 3 \text{H}_2(g) + \text{N}_2(g) \rightarrow 2 \text{NH}_3(g) \]
\[ V = k n \]
\[ V = \left(\frac{T}{p}\right)n \]

IDEAL GAS LAW

\[ PV = nRT \]

\[ R = 0.0821 \text{ atm} \cdot \text{L} / \text{mol} \cdot \text{K} = 8.314 \text{ K} \cdot \text{mol} \cdot \text{L} / \text{K} \cdot \text{mol} \cdot \text{K} \]

STP \( T = 273 \text{ K} \)

\[ n = 1.0 \text{ mol} \Rightarrow V = 22.4 \text{ L} \text{ STP} \]

Water volume

BOYLE'S LAW

\[ PV = k \]

\[ P = \frac{k}{V} \text{ INVERSE RELATIONSHIP} \]

if \( T, n \) is constant

\[ P_1V_1 = P_2V_2 \]

at const. \( T, n \)

CHARLES'S LAW

\[ \frac{V}{T} = k \]

\[ V = kT \]

if \( P, n \)

\[ y = mx + b \]

are constant

DIRECT (LINEAR)

\[ \frac{V_1}{T_1} = \frac{V_2}{T_2} \text{ if } P, n \text{ constant} \]

GAY-LUSAC'S LAW

\[ \frac{P}{T} = k \]

\[ P = kT \]

DIRECT

\[ \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \]

at const. 

\[ \frac{P_1}{T_1} = \frac{P_2}{T_2} \text{ at cons} \]

\[ \frac{V_1}{n} \]

COMBINED GAS LAW \( n = \text{constant} \)