CHAPTER 5 GASES

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

PARTICLES ARE FAR APART FROM EACH OTHER

$F = \frac{kQ_1Q_2}{r^2}$ IMF's ≈ 0

IMF = 0 → "ideal gas"

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

"standard" P = 760 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

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③ Gas particles are not attracted to or repulsed by each other (NO IMF's)

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

$KE = \frac{1}{2}mv^2$ < $K = {}^{\circ}C + 273$ ${}^{\circ}C = K - 273$ >

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 & P the volume of a gas is directly proportional to the number of moles present

$V \propto n$ if T, P are constant

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

$3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$

$V = kn$

$V = \left(\frac{T}{P}R\right) n$

$PV = nRT$ IDEAL GAS LAW

$R = 0.0821 \frac{atm \cdot L}{mol \cdot K} = 8.314 \frac{kPa \cdot L}{mol \cdot K} = 62.4 \frac{mmHg \cdot L}{mol \cdot K}$ (torr)

STP $T = 273K$ $n = 1.0 mol \Rightarrow V = 22.4L$ @ STP

(V = molar volume)

BOYLE'S LAW

$PV = k$

if T, n is constant

$P = \frac{k}{V}$ INVERSE RELATIONSHIP

$P_1V_1 = P_2V_2$ at const. T, n

CHARLES'S LAW

$\frac{V}{T} = k$ $V = kT$

if P, n are constant

$y = mx + b$

DIRECT (LINEAR)

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ if P, n constant

GAY-LUSSAC'S LAW

$\frac{P}{T} = k$ $P = kT$

DIRECT

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ at const V, n

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ COMBINED GAS LAW $n = \text{constant}$