GASES
Chapter 10
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IDEAL BEHAVIOR

-perfectly elastic fluid

1. Random motion (temp)
2. Elastic collisions
3. No Van der Walls forces
4. Large Separation Distance
5. Particles of the gas have <u>no</u> volume (act like there's no potential well)

-infinitely compressible

NON-IDEAL BEHAVIOR

-at low temperatures and high pressure, compressibility becomes very difficult. Attraction is about the same as collision, separation distances are small and particle volume becomes significant.

DIFFUSION/EFFUSION

-depends upon the kinetic energy ($1/2mv^2$) of the molecules

-rate of effusion $\propto$1/square root(molecules weight)

PRESSURE

-pressure is caused by the force of particle collisions

-newton's second law: F=Ma (where a is the deceleration)

-SI unit is the Pascal, is equivalent to 1 Newton of force per square meter

Pressure = force/unit area

101,325 Pa = 1 atm

1 atm = 760 mgHg = 760 Torr

-Atmosphere pressure is capable of supporting a column of water about 34 feet high, or a column of Mercury about 30 inches (a little more than 14 pounds of weight per square inch of surface)

BOYLE'S LAW

-the first "law" of chemistry is a relationship between volume and pressure

$P_1V_1 = P_2V_2$ At constant temperature

-P $\propto$1/V

-P=k(1/V)

-PV = K

-Graph's of Boyle's Law

CHARLES LAW

-Charles discovered that volume changes by 1/273 of the gases original volume for every 1 K
-Graphs

-Important point: keep temperature in KELVINS
-This means V=kT or V/T = k or

$V_1/T_1 = V_2/T_2$ at constant pressure

GAY - LUSSAC LAW

-This is the law of "particle collisions"
-Graphs

-P = kT P/T = k $P_1/T_1 = P_2/T_2$ at constant Volume

ABSOLUTE ZERO

-This can now be defined as the temperature at which an (ideal) gas exerts no *pressure* and occupies no *volume*.
-Van der Waals forces take over before this point and a gas shows its non-ideal behavior by liquefying.

IDEAL EQUATION OF STATE

-blending together all three gas laws:

$P_1V_1/T_1 = P_2V_2/T_2$

EARTH'S ATMOSPHERE

-Total mass of atmosphere - 5.2 Zg (5.2×10^{21})

Nitrogen = 76.484%
Oxygen = 20.446%
Steam = 2.0% (water vapor)
Rare (Ar)= .934%
CO_2 = .033%

MIXTURES OF GASES

Amagat's Law of Gas Mixtures

-If 2 or more gases at the same temperature and pressure are mixed, then volume is conserved.
-If volum3 is NOT conserved during mixing, the Pressure and Temperature are NOT constant (maybe a chemical reaction occurred)

Dalton's Law of Partial Pressure

-The total pressure in a system is the sum of the partial pressures of the gases involved.

$P_{total} = P1 + P2 + P3 + ...$

-The pressure fraction is equal to the mole fraction (irrespective of mass)

$P_{part}/P_{total} = Mol_{part}/Mol_{total}$

Avogadro's Law

-If KMT dictates that all particles have the same (insignificant) volume, then equal volumes of gases contain equal numbers of particles.
-This is history in reverse!

$V \propto n$ (n = # of moles)

$V/n = k$

$V_1/n_1 = V_2/n_2$ OR $V_1/V_2 = n_1/n_2$

IDEAL GAS LAW

-a combination of Boyle's , Charles, Gay-Lussac, and Avogadro's

$PV = nRT$

-remember!: $n = m/M$ (Molar mass divided by mass)

$M/V = p$ (density) so: $PM = pRT$

UNIVERSAL GAS CONSTANT (R) pg 342

$PV/NT = R$

-measured in J/molK

- 8.3145 for kPa or .0821 for atm

EQUATIONS

Boyle's: $P_1V_1 = P_2V_2$

Charles: $V_1/T_1 = V_2/T_2$

Gay-Lussac: $P_1/T_1 = P_2/T_2$

Ideal Equation of State (combination of above three): $P_1V_1/T_1 = P_2V_2/T_2$

Dalton's: $P_{part}/P_{total} = Mol_{part}/Mol_{total}$

Avogadro's: $V_1/n_1 = V_2/n_2$

Ideal Gas Law: $PV = nRT$