Gas Notes

Kinetic Molecular Theory- all particles are in motion.

	Solids	Liquids	Gases
Condensed/Non Condensed	Condensed	Condensed	Non-Condensed
Distance between particles	Closely packed	Closely packed	Loosely packed
Compressibility	No	No	Yes
Definite Shape	Yes	No	No
Definite Volume	Yes	Yes	No
Take shape of container	No	Yes	Yes
Will it expand to take the volume of container	No	No	Yes
Energy of Particle (Speed)	Low	Medium	High
Density	High	High	Low

Gas Variables

V = Volume- space occupied by a sample of gas (mL or L)
P = Pressure- force exerted over an area (kPa, atm, mm Hg, torr)
T = Temperature- measure of average kinetic energy of the particles of a gas sample (˚C, K)
n = Moles- the number of moles of a sample (moles)

Variable	Constants	Relationships	Between Variable
P, V	n,T	P↓V↑ P↑V↓	Inverse
T, V	n, P	T↑V↑ T↓V↓	Direct
T, P	n, V	T↑P↑ T↓P↓	Direct
n, P	T, V	n↑P↑ n↓P↓	Direct
n, V	T, P	n↑V↑ n↓V↓	Direct
n, T	P, V	n↓T↑ n↑T↓	Inverse

Conversions

Temperature Units

$T_{Kelvin} = T_{Celsius} + 273$

$T_{Celsius} = T_{Kelvin} - 273$

Pressure Units

1 atm = 760 torr = 760 mm Hg = 101.325 kPa

For all gas law equations, temperatures must be in Kelvin!

STP- Standard Temperature and Pressure

Standard Temperature = 0˚ Celsius = 273 Kelvin
Standard Pressure = 1 atm = 760 mm Hg = 101.325 kPa

Procedure for using gas laws

1. Write down all given values.
2. Determine the correct gas law to use.
3. Make any necessary conversions.
4. Solve the equation for the unknown value.
5. Input the known quantities into the equation.
6. Solve.

Boyle's Law
When T & n are held constant
P & V are inversely proportional

$\mathbf{P_1V_1=P_2V_2}$

Charles' Law
n & P are held constant
V & T are directly proportional
TEMPERATURE MUST BE IN KELVIN!

$\mathbf{\frac{V_1}{T_1} = \frac{V_2}{T_2}}$ or $\mathbf{V_1T_2 = V_2T_1}$

Gay Lussac's Law
n & V are held constant
P & T are directly proportional
TEMPERATURE MUST BE IN KELVIN!

$\mathbf{\frac{P_1}{T_1} = \frac{P_2}{T_2}}$ or $\mathbf{P_1T_2 = P_2T_1}$

Combined Gas Law
n is held constant
TEMPERATURE MUST BE IN KELVIN!

$\mathbf{\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}}$ or $\mathbf{P_1V_1T_2= P_2V_2T_1}$

Ideal Gas Law
TEMPERATURE MUST BE IN KELVIN, VOLUME IN LITERS, PRESSURE IN ATM!

$R = 0.0821 \frac{atm \bullet L}{mol \bullet K}$

PV = nRT

To solve for molar mass

$\mathbf{M.M. = \frac{mRT}{PV}}$

$\mathbf{Density = \frac{M.M * P}{R * T}}$

Dalton's Law of Partial Pressure- total pressure is equal to the sum of the pressure of each individual gas
$P_{Total}= P_1 + P_2 + P_3 \ldots$