BEHAVIOR OF GASES

Three Variables: V, T, and P

Pressure:

Increase in gas = increase in gas particles
↓
Gas pressure increases

Double - everything doubles

↑ pressure too much, container will bust!!! (exceeds the strength of the container)

Volume:

↓ V by 1/2, then that gas P doubles

↑ the volume by doubling, then the gas pressure will reduce by 1/2.

Gases cool when they expand and heat when they are compressed. (ex. Air conditioning system)

Temperature:

Doubling the T of an enclosed gas will double the gas pressure.

Halving the T of an enclosed has decreases the P by 1/2.

Dalton's Law of Partial Pressures: -

$P_{total} = P_1 + P_2 + P_3$ etc.

All pressures in a mixture of gases = total P
(at constant V and T)

If you have a tank filled with N_2, O_2, and CO_2 and the pressure of N_2 = 10 atm and O_2 = 4 atm, what is the pressure of CO_2 if the total pressure of the tank = 40 atm?

Dalton's Law of Partial Pressures

$P_{total} = P_1 + P_2 + P_3$

40 atm = 4 + 10 + x
26 atm

Boyle's Law:

At constant T for a given mass, the V of a gas varies INVERSELY with P.

$P_1V_1 = P_2V_2$

When pressure decreases, the volume increases.

Ex. Scuba diving: every 10 m of depth, add 1 atm. Scuba equipment provides air to lungs or increases pressure to match the environment.

Charles' Law:

When P is constant, the V of a mass of gas is directly proportional to T. (T - Kelvin)
K = °C + 273

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

If a sample of gas occupies 6.8 L at 327 °C, what will be the volume at 27 °C if the P doesn't change?

Gay-Lussac's Law

At constant V, the P of a gas is directly proportional to T. (T - Kelvin)

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

If a gas has a P of 50.0 mm Hg at 540 K, what will be the P at 200 K if V doesn't change? (V is constant)

Combined Gas Law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

At a pressure of 800. mm Hg and 25 deg C, a gas has a volume of 450 mL. What will be the volume of this gas under standard conditions?

Ideal Gas Law:

Allows to solve for the number of moles

PV = nRT (at STP)

P = atm (kPa) (mm)
V = L
n = mol (reminder: $12g\ CO_2 \times \frac{1\ mol\ CO_2}{44\ g\ CO_2}$)

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

OR

8.31 $\frac{L*kPa}{K * mol}$

T = K

Ideal Gas Examples

1. When a sphere containing 680 L of He gas is heated from 300 K to 600 K, the pressure increases to 18 atm. How many mol of He does the sphere have?

2. What V will 12.0 g of O_2 occupy at 25 °C and P of 0.520 atm?

3. Calculate the number of L at STP.

A. 2.5 mol N_2

B. .600 g H_2

C. 350 mol O_2

Diffusion and Graham's Law:

Effusion vs. Diffusion

Effusion: gas escapes thru tiny openings

**Effusion of a gas is inversely proportional to the square root of its gfm. (gmm)

-His law states that lighter gases will effuse faster than heavier gases.

Ex. Balloons

O_2, N_2, etc (air) He

Which will diffuse faster thru the pores in the balloon causing deflation?

$$\frac{\text{Rate of effusion of A}}{\text{Rate of effusion of B}} = \frac{M_B}{M_A}$$