NOTES #33 THE GAS LAWS:

Draw Experimental apparatus here↓:

I. BOYLE'S LAW:
The Pressure - Volume Relationship

a. The volume of a given amount of gas at constant temperature is _____ proportional to the pressure applied to the gas. In other words, as pressure INCREASES, volume _____.

b. Mathematically, we can write this law two ways: _____ OR _____.

c. Rearranging yields a mathematical statement of Boyle's Law. _____
The product of P x V is a constant for a fixed amount of gas at constant temperature. Take a look . . .

Trials	#1	#2	#3	#4	#5	#6
P (mmHg)	724	869	951	998	1230	1893
V (liters)	1.50	1.33	1.22	1.16	0.94	0.61
P x V	1090	1160	1160	1200	1200	1100

d. For changes in pressure from P_1 to P_2, we can apply Boyle's Law. Since the product P x V is a constant, its value at the initial pressure, P_1, and its volume, V_1, will EQUAL P x V at the final pressure, P_2, and the final volume, V_2.

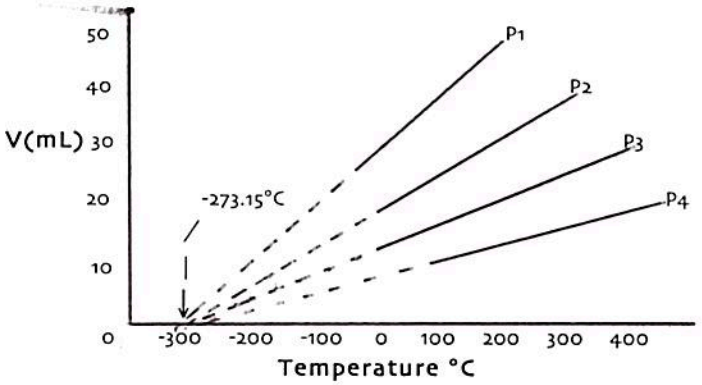
$P_1V_1 = P_2V_2$ when _____&_____ are held constant.

II. CHARLES'S LAW: *The Temperature – Volume Relationship*

a. At constant pressure and moles, the volume of a gas is directly proportional to its *absolute* temperature in units of _____.

b. Mathematically, we can express this as:
_____.

c. Rearranging, we get another form of Charles's Law,
_____. Since V/T is equal to a constant, then V_1/T_1 at an initial temperature, T_1, and volume, V_1, will be equal to V_2/T_2 at a final temperature, T_2, and volume, V_2.



d. Charles's Law allowed for the prediction of ABSOLUTE ZERO, the temperature at which ALL _____stops. Look above!↑

III. AVOGADRO'S LAW: *The Volume – Amount Relationship*

a. At the same temperature and pressure, equal volumes of ANY gas contain the _____ number of molecules (or moles). In other words, the volume of gas is _____ to the number of moles present.

b. It's been found that 1 mole of ANY gas at STP (standard temperature and pressure) will occupy a volume of _____. This is a very useful conversion. If you know the volume of a gas (x), after correcting for the temperature and pressure (STP), the moles can be determined: ↓

c. STP = Standard Temperature and Pressure: _____ atm $\frac{\text{x liters}}{22.41\ \text{L/mol}}$ = moles

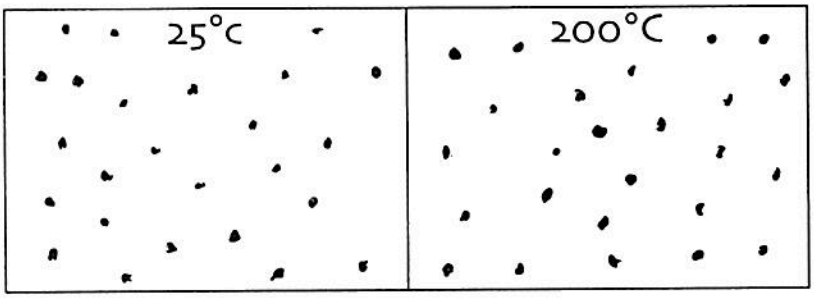
IV. GAY-LUSSAC'S LAW: *The Temperature – Pressure Relationship*

a. As the *absolute* temperature of a gas is increased its pressure will increase in a manner that is _____ proportional to the temperature. This is true as long as the volume and amount of moles are held constant.

b. Upon heating, the kinetic energy of the surroundings is transferred the gas in the container. Remember, KE(ave) ∝ Temperature, so if T↑, KE↑. If KE ↑, then velocity ↑, due to KE = 1/2mv^2. As the molecules travel with greater velocities, they will exert greater collision forces on the inner surface of the container. Since → Pressure = Force/Area, T↑ ∝ P↑.

Gas Laws - a molecular level.

Scenario #1 *Temperature - Pressure Relationships* [Must keep _____ & _____ constant]



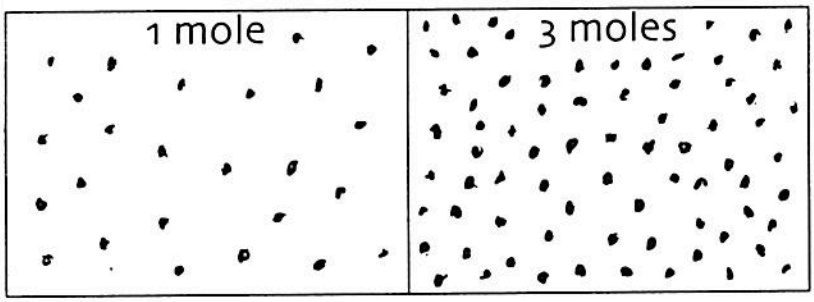
A sample of gas was heated from 25°C to 200°C.
1. What will happen to the pressure exerted by this gas?

_____

2. Explain how each of the following factors does or does not contribute to the pressure change that occurs when the temperature increases.

a) Collisions per unit time
b) Energy per collision
c) Number of particles per unit volume.

Scenario #2 *Pressure & # of Particles* [Must keep _____ & _____ constant]



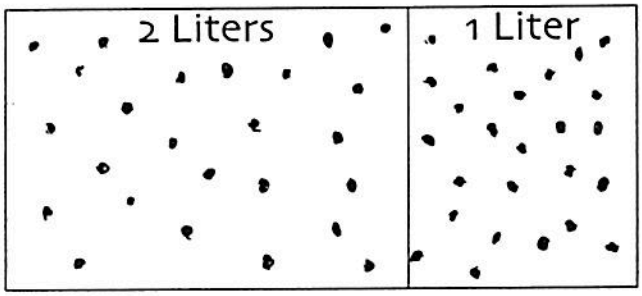
A container initially holds 1 mole of gas and then 2 additional moles are added.
1. What will happen to the pressure exerted by this gas?

_____

2. Explain how each of the following factors does or does not contribute to the pressure change that occurs when the temperature increases.

a) Collisions per unit time
b) Energy per collision
c) Number of particles per unit volume.

Scenario #1 *Pressure - Volume Relationships* [Must keep _____ & _____ constant]



A sample of gas was initially in a 2 liter container and then the volume was reduced to 1 liter.
1. What will happen to the pressure exerted by this gas?

_____

2. Explain how each of the following factors does or does not contribute to the pressure change that occurs when the temperature increases.

a) Collisions per unit time
b) Energy per collision
c) Number of particles per unit volume.