Partners: Name: _____ Per: _____

Gas Laws Simulation

Background

In this investigation you will examine three gas laws including Boyle's Law, Charles' Law and Gay-Lussac's Law. You will explore how manipulating the variables of volume (L), pressure (atm) and temperature (K) can affect a sample of gas.

Important Terms

Direct relationship: A relationship between two variables, where a change in one variable results in the same change in the other variable. For example, if one variable is increased, then the other variable will also increase.

Indirect relationship: A relationship between two variables, where a change in one variable results in the opposite change in the other variable. For example, if one variable is increased, then the other variable will decrease.

Pre-Simulation Questions

1. Briefly describe, in your own words the meaning of each of the following variables, and common units of measurement associated with each:
   a. Volume

   b. Pressure

   c. Temperature

Procedure

Click on GAS LAW SIMULATION which is found on the class website: pcoe.weebly.com

Boyle's Law - The "Boyle's Law" tab should be white.

1. Which one of the three variables: Pressure, Volume or Temperature cannot be changed in Boyle's Law? This variable is considered a constant.

2. Using the volume control arrows, lower the volume of the gas to 1.70L (make V2 = 1.70L)
   a. Record your observations regarding the behavior of the particles (orange dots) in the gas sample as the volume is reduced. Make certain to discuss *collisions* in your comments.

   b. Click calculate for pressure, P_2. What is P_2? _____
   c. Since the volume decreased, does pressure increase or decrease? _____ Justify your answer using the kinetic molecular theory (collisions) of gas particles.

3. Press the *reset* button at the top right of the screen.
   a. Using the pressure control arrows, decrease the pressure (P_2) value to 0.50 atm, press "Calculate", what is the new volume, V_2? _____
   b. Press the *Add Data* button. Using the pressure control arrows, increase the pressure to 0.70 atm, what is the new volume, V_3? _____
   c. Repeat step b for pressure values of 1.80atm and 2.70atm.
   V_4=_____ V_5=_____
   d. Draw the trend in the graph to the right. Include units and axis labels.
   e. Based on the data collected, what trend can be observed between pressure and volume? Fill in the blanks.

      As pressure increases, volume _____.

      As pressure decreases, volume _____.

   f. Considering the terms described at the start of this worksheet, do the variables of pressure and volume have a *direct* or an *indirect* relationship in Boyle's Law? Justify your answer.

Charles' Law - Change the simulation to "Charles' Law" by clicking the tab at the top.

1. Which one of the three variables cannot be changed in Charles' Law? This variable is considered a constant.

2. Using the Temperature controls, increase the temperature of the gas to 443 K.
   a. What changes do you observe in the behavior of the particles of the gas while the temperature is increased?

   b. Click calculate for V_2. What is the value of V_2? _____

3. Press the *reset* button.
   - Using the temperature control arrows, increase the volume value to the 2nd measurement in the table. Then press calculate and fill in the temperature column for the new Temperature value.
   - Then press *Add Data*. Select the next volume and press calculate for the new temperature. Record the temperature for the T_3, T_4 & T_5.
   - Fill in the table to the right and graph the trend in the graph to the right. Label axis.

	Volume	Temperature
1	3.00 L	298 K
2	1.10 L	
3	2.00 L	
4	4.10 L	
5	5.30 L	

   a. Based on the data collected on the graph, what trend can be observed between volume and temperature? Fill in the blanks.

      As volume increases, temperature _____.

      As volume decreases, temperature _____.

4. Is Charles' law considered a *direct* or an *indirect* relationship between the variables? Justify your answer.

Gay-Lussac's Law

Change the simulation to "Gay-Lussac's Law" by clicking the tab at the top of the screen it will be shown in white.

1. What variable is held constant in Gay Lussac's law? _____
2. Using the temperature control arrows, reduce the temperature of the gas to 158 K.
   a. Record your observations regarding the behavior of the particles in the gas sample as the temperature is reduced. Make certain to discuss *collisions* in your comments.

   b. What is the new pressure, P_2? _____
3. Press the *reset* button at the top right of the screen.
   a. Using the pressure control arrows, increase the pressure value to 1.50 atm, what is the new temperature? T_2 = _____
   b. Press the *Add Data* button. Using the pressure control arrows, increase the pressure to 2.00 atm, what is the new temperature? T_3 = _____
   c. Repeat step b for pressure values of 2.50 atm and 2.90 atm. T_4 = _____ and T_5 = _____
   d. Draw the trend in the graph to the right. Include units and axis labels.
   e. Based on the data collected, what trend can be observed for temperature and pressure of a gas?

      As temperature increases, pressure _____.

      As temperature decreases, pressure _____.

   f. Is this considered a *direct* or an *indirect* relationship between the variables? Justify your answer.

Summary of the Three Main Gas Laws

	Boyle's Law	**Charles' Law**	**Gay-Lussac's**
Constant			
Trend	As _____ increases, _____ decreases and vice versa.	As _____ increases, _____ increases and vice versa.	As _____ increases, _____ increases and vice versa.
Relationship			
Graph			

Checking Comprehension – Explain what happens in each of the demonstrations, don't just summarize what happened.

1) Demonstration #1 – Which gas law is applied in this demonstration? _____

2) Demonstration #2 – Which gas law is applied in this demonstration? _____

3) Demonstration #3 – Which gas law is applied in this demonstration? _____

4) Considering what you now know about Boyle's law, make a prediction based on the following situation: What would happen to the pressure of a gas inside a sealed bottle, if the bottle was squeezed tightly, reducing the volume of the gas by half? Explain your thoughts.

5) Considering what you now know about Charles' law, make a prediction based on the following situation: What would happen to the volume of a gas inside a sealed bottle, if the bottle was heated to double its original temperature? Explain your thoughts.

6) Considering what you now know about Gay-Lussac's law, make a prediction based on the following situation: What would happen to the pressure of a gas inside a glass bottle (volume constant), if the bottle was cooled to half of its original temperature? Explain your thoughts.