

Gay-Lussac's Law Activity

Pressure and Temperature

Go to <http://phet.colorado.edu/en/simulation/gas-properties> . Click on "Run Now."

In this activity, you will be looking at the relationship between pressure and temperature of a gas.

First, you need to add a gas to your container. **Change the "Gas in Chamber" to read 100 molecules of Heavy (blue) species.**

Describe the motion of the particles: _____

Grab the handle of the pump and add another pump-full. Besides the obvious change in the amount of gas, what else changes in your container?

Click the "Reset" button in the lower right.

In this activity, we want to examine the relationship between *PRESSURE* and *TEMPERATURE* only. You must set your container to constant volume. Click on the *Volume* button in the "Constant Parameters" on the upper right corner. This should lock your volume at a constant value.

As soon as you select *constant volume*, what happens to the box? _____

Change the gas to 200 molecules of the HEAVY species by manually setting this in the right box.

You are going to adjust the temperature of the container by adding or removing heat using the *Heat Control* under the container. The temperature of the internal environment is found above the container.

In what units is temperature reported? _____

Using the internet, determine the relationship between Kelvin and Celsius.

Temperature is a relative measure of energy. What temperature is your box at? _____

Increase the temperature by using the "Heat Control" under your container. How does this affect *the motion* of the particles in your container? _____

Decrease the temperature. What happens to the motion of the particles? _____

Return the temperature to 300 K.

The pressure gauge is found on right side of the container. What units is the pressure measured in? _____

Again, increase the temperature to 600 K.

What happens to the *number of collisions* between the molecules and the container wall?

In the end, how does this change affect the pressure of the container? What is the new pressure?

Fill in **Data Table #1** by selecting various temperatures and recording the corresponding pressure on the pressure gauge. **Choose a wide range of temperatures. But don't go too hot!**

Include units. Calculate the values as indicated in the other columns.

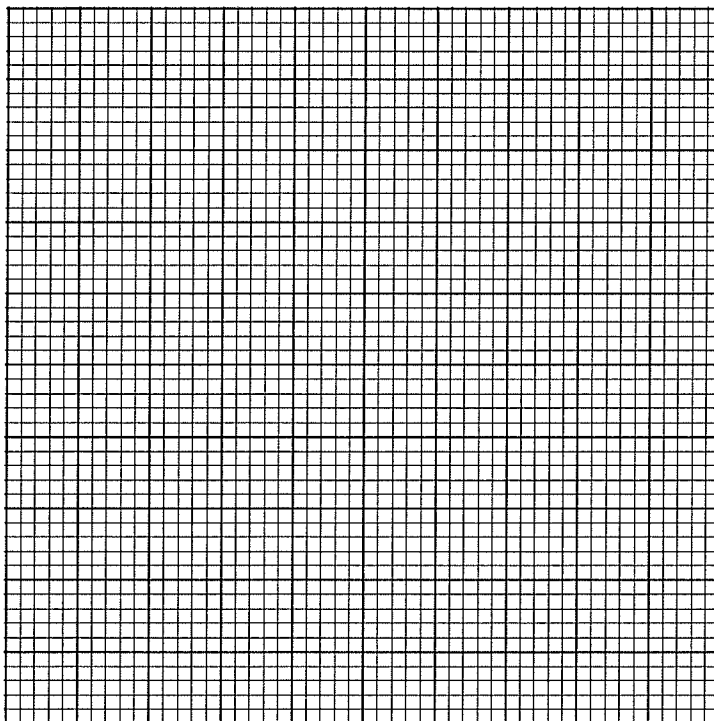
DATA TABLE #1

Trial	Temperature (T)	Pressure (P)	Calculate $k_1 = (P \times T)$	Calculate $k_2 = \frac{P}{T}$
Trial 1	300 K			
2				
3				
4				
5				
6				

Which variable did you manipulate (independent)? _____

Which variable is the dependent variable? _____

Graph Pressure vs. Temperature in the following graph. Use proper scaling. Label the graph appropriately. Graph the line of best fit.



Looking at your data and graph, describe the relationship between temperature and pressure.

As the temperature gets colder and approaches 0 K, what happens to the motion of the particles?

As the temperature gets approaches 0 K, what happens to the pressure of the container?

Increase the temperature to 2000 K, what happens to your container? _____

Which value remains consistent in the data table? k_1 or k_2

Note: the other k-value is worthless and proves nothing.

Looking at the top of Data Table #1, what does this "k" value equal?

Let's call the first set of data points P_1 and T_1 and the second set of data points P_2 and T_2 and so on. Since all trials have roughly the same chosen k-value, set the k-values to equal each other. Write an appropriate equation using the variables P_1 , T_1 , P_2 , and T_2 .

This is Gay-Lussac's Law between Pressure and Temperature of a Gas. Learn it. Know it. Use it.

We can use this formula to predict the pressure (P_2) or temperature (T_2) of any gas. Use this formula to complete the following calculations. When doing these calculations, it is necessary for the pressure to have the same units. Identify all variables and then substitute and solve.

1. If a gas has a pressure of 1.69 atm at a temperature of 300 K, what will the pressure change to if the container is cooled to 100 K?
2. If a gas has a pressure of 715 mm Hg at the temperature of 500 K, what will the pressure change to if the container is heated to 900 K? What is this pressure in atm?
3. On the side of aerosol cans, there is warning against heating the container. If the gas inside the container is at a pressure of 5.9 atm at room temperature (22°C), what will the pressure of the can be if the can is heated to 100°C ? *Remember to convert to Kelvin.*
4. If a container of gas has a temperature of 290 K and a pressure of 1.85 atm, to what temperature would you have to heat the container to achieve a pressure of 4.75 atm?