Chemistry – Gas Laws

Name _____

Period _____ Date _____

Charles' Law Activity

Volume 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 *VOLUME* 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*. Let the box equilibrate.**

What is the pressure of your container? _____

In this activity you are examining the relationship between *VOLUME* and *TEMPERATURE* only. You must set your container to *constant pressure*. Click on the *Pressure* button in the "Constant Parameters" in the upper right corner. This should lock your pressure at a constant value (it might fluctuate a very small amount).

As soon as you set the pressure to constant, what happens to the little man next to the box? _____

_____

This little robot is responsible for changing the volume of the container. His position will fluctuate. ***When you are trying to measure the volume of the container, you must estimate the best average position and record this value.***

This simulation does not have a tool to measure the volume of the container, so we need to devise one.

Click on the "Measurement Tools" button on the right side. Click on the *Ruler*.

This will cause a ruler to appear. The rulers units are in nanometers (nm) but we are going to use the ruler to give us an estimated measurement of volume. **Click on and drag the ruler anywhere you want.** You will use the ruler to measure the width of the box. We will then change the units of measurement to *liters*. For example: initially the box should have a width of 6.6 nm which will be recorded in your data table as 6.6 L (liters). When you are asked to change/measure the volume of the box, use the ruler to do so.

What are the graduations on the ruler? (How much is each notch worth?) _____

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

What ***units*** is temperature measured in the container? _____

Write an equation relating degrees Celsius and Kelvin: _____

Increase the temperature, what happens to the motion of the particles? _____

We set pressure to be a constant value. What causes pressure in the container? _____

_____

If the particles are moving faster but we don't want them to hit the walls anymore than previously, what is going to have to change??? Think about it.

Fill in **Data Table #2** by selecting various temperatures and measuring the corresponding volume of the container using the ruler. ***Use temps between 150 K and 450 K!***

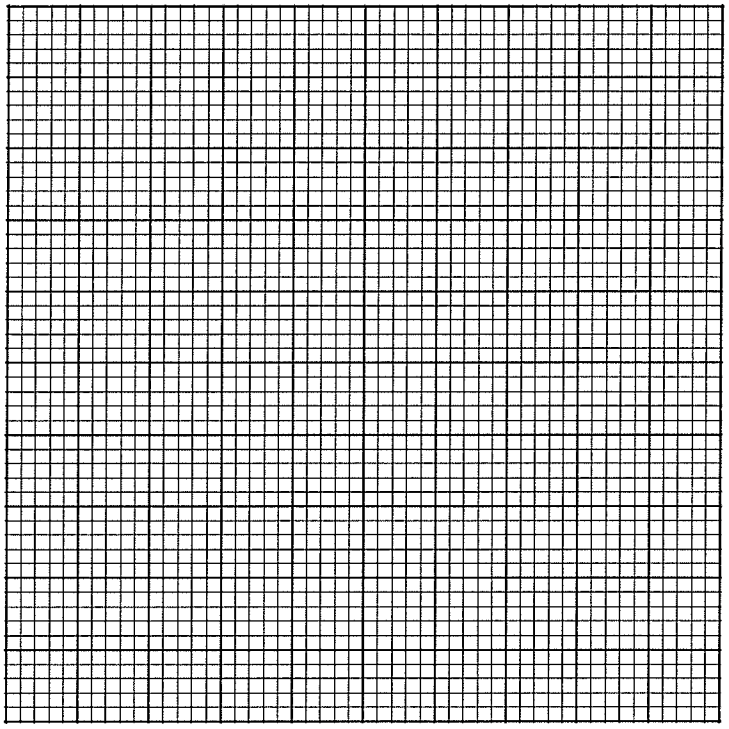
Calculate the values as indicated in the other columns.

Trials	Temperature (T)	Volume (V)	Calculate $k_1 = (VxT)$	Calculate $k_2 = \frac{V}{T}$
Trial 1	300 K			
2				
3				
4				
5				
6				

Which variable did you manipulate (independent)? _____

Which variable is the dependent variable? _____

Graph Volume 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 volume.

_____

As the temperature gets colder and approaches 0 Kelvin, what happens to the volume of the gas?

_____

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 #2, what does this "k" value equal?

Let's call the first set of data points V_1 and T_1 and the second set of data points V_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 V_1, T_1, V_2, and T_2.

This is Charles' Law between Volume and Temperature of a Gas. Learn it. Know it. Use it.

We can use this formula to predict the volume (V_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 volume of 1.25 L at a temperature of 300 K, what will the volume change to if the container is cooled to 200 K?

2. If a gas has a volume of 3.67 L at the temperature of 500 K, what will the volume change to if the container is heated to 900 K?

3. A balloon bought in a store where the temperature is 22° C has a volume of about 3.12 L. The person takes the balloon outside on a hot day of a temperature is 37° C. What is the new volume of the balloon? *Becareful of the Temp Units!!!*

4. If you did buy a 2.75 L balloon that had a temperature of 23° C, what temperature would you have to heat the balloon to in order to increase the volume to 5.00 L?