Chemistry – Gas Laws Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period \_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Charles’s Law Computer Activity

Follow instructions from your teacher to access and open the *Gas Properties Simulation*. Or you can go to <http://phet.colorado.edu/en/simulation/gas-properties>.

Open the simulation.

Click on the “Measurement Tools” button. 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. 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?) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

First, you need to add a gas to your container. Click on the handle of the pump, and add ONE PUMPFUL of gas to your container. Locate the “Gas in Chamber” data on the right.

How many gas particles did you add to your container? \_\_\_\_\_\_\_\_\_\_\_\_

What type of gas did you add? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Describe the motion of the particles: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You can manually set the number of particles in the chamber by typing in a number in the “Gas in Chamber” boxes. Change your gas from heavy species to **100 light species**.

How does the motion of the light gas compare to heavy gas? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change the gas to 100 molecules of the HEAVY species.

Charles’s Law looks at the relationship between temperature and volume at a constant pressure. You must set your container to constant pressure. Click on the Pressure button in the ”Constant Perameters” on the upper right corner. This should lock your pressure at a constant value (it might fluctuate a very small amount).

What is the pressure of your container? \_\_\_\_\_\_\_\_

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.

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

What units is temperature in? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Using your book or the internet, determine the relationship between Kelvin and Celsius.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Fill in the following chart by selecting various temperatures. (For example 150 K, 300 K, 600 K, etc.) .

Measure the volume of the container using the ruler.

|  |  |  |
| --- | --- | --- |
| Trials | Temperature (T) | Volume (V) |
| Trial 1 | 300 K |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| 6 |  |  |

Which variable did you control (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?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the mathematical equation that relates temperature and volume? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Use this equation (Charles’s Law) to complete the practice problems below.

**Practice**

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 295 K, what temperature would you have to heat the balloon to in order to increase the volume to 5.00 L? What is this in Celsius?