Chem I

Name ____________________________

Date _________________ Per _______

Charles' Law Computer Lab

This lab is a simulation of one of the most important labs done in the history of the study of gas laws. We can't actually recreate it in the lab because it involves the use of a great deal of mercury.

You will need this sheet, a calculator, a pencil, a computer, and a focused mind. This lab does not do all the calculations for you, so be ready to do some math as you go.

To begin: Go to http://www.chm.davidson.edu/ChemistryApplets/GasLaws/CharlesLaw.html

1. Read the section called "Concepts", answering the following as you go:

   a. During what time period was this experiment done? ___________________________

   b. _____________ Charles and _______________ Gay-Lussac made detailed measurements on how the ____________ of a gas was affected by its _____________

   c. Why were they interested in this subject? ___________________________________

   ____

   d. To do his experiment, Charles trapped a quantity of gas in a __________ glass tube that was _____________ at one end. This tube was immersed in a _______________. In order to change the temperature of the gas, all Charles had to do was change the temperature of the ________________. The pressure was held constant by adjusting the height of the ________________ so that the two columns of ________________ had _______________ height. This kept the pressure of the gas trapped inside the tube always equal to the _______________________ pressure.

   e. One of the goals of this lab is to show that the relationship between V and T is linear. The other is to find what the temperature of a gas must be when the volume drops to _____________. This temperature is called _______________ _____________.

2. The Experiment

   a. What's the color of the sample of air that's trapped in the J-tube? _______________

   b. What's the pressure of the trapped gas when the mercury levels are equal?

   ____

c. Now for some calculations: (be sure to record units - they make a big difference)

What is the inside diameter of the tube? _____________

What is the inside radius of the tube? r = _____________ (this is more important)

What is the height of the column of green gas? Hint: you need to do a subtraction here.

h= _________mm- __________ mm = ____________ mm, which equals ________ cm

The inside of the tube is a cylinder. The formula for the volume of a cylinder is

$$V_{cylinder} = \pi r^2 h$$

Calculate the volume of the green gas in cm^3

Answer: V = _____________ cm^3

What's the temperature reading at this volume? _____________________

Enter your data on the data table on the last page: (remember 1 cm^3 = 1 mL)

Enter your data in the program by putting the volume and temperature where they belong and clicking "Add Point". A point should appear on the graph to the right.

d. To get the next point, click and hold on the red temperature line and move the temperature up or down. (This is like changing the temperature of the water bath, only easier.) Notice that the mercury levels move. When you've decided on the next temperature you want, adjust the mercury levels so that they are both exactly the same by clicking on the "-Hg-" and "+Hg+" buttons at the bottom of the grey part of the tube. You'll have to calculate each new volume that will go with each new temperature. Show your work in the space provided. For the best possible results spread out the temperatures as much as possible. You need to get a total of 6 different points for the graph.

Point 2: Temperature = ________________________________

Height of the column (after the subtraction): _______ cm

Calculate the volume of the green gas in cm^3 ($V_{cylinder} = \pi r^2 h$)

Answer: V = _____________ cm^3

Record this data on the computer AND on the data table on the last page.

Point 3: Temperature = ________________________________

Height of the column (after the subtraction): _______ cm

Calculate the volume of the green gas in cm^3 ($V_{cylinder} = \pi r^2 h$)

Answer: V = _____________ cm^3

Record this data on the computer AND on the data table on the last page.

Point 4: Temperature = ________________________________

Height of the column (after the subtraction): _______ cm

Calculate the volume of the green gas in cm^3 ($V_{cylinder} = \pi r^2 h$)

Answer: V = _____________ cm^3

Record this data on the computer AND on the data table on the last page.

Point 5: Temperature = ________________________________

Height of the column (after the subtraction): _______ cm

Calculate the volume of the green gas in cm^3 ($V_{cylinder} = \pi r^2 h$)

Answer: V = _____________ cm^3

Record this data on the computer AND on the data table on the last page.

Point 6: Temperature = ________________________________

Height of the column (after the subtraction): _______ cm

Calculate the volume of the green gas in cm^3 ($V_{cylinder} = \pi r^2 h$)

Answer: V = _____________ cm^3

Record this. Both places. You know the drill.

Data:

Temperature (ºC)	Volume (mL)

e. An "outlier" is a point that is obviously not on the same line as all the other points. **If you have any outliers, delete them**. (That's why we wanted no fewer than 6 points for the graph). If you have time, go back and see what went wrong with those points. The most common mistake in this lab is to forget to adjust the mercury after changing the temperature.

f. Calculating absolute zero: The equation of a line is y = mx +b.

For your line, y = the volume, x = the temperature, m = the slope and b = the intercept (The slope and the intercept are given on the computer right under the graph.)

Since the temperature called absolute zero will occur (in theory) when the volume of the gas is zero, set up your equation so that y = zero and solve for x. That should give you the temperature of absolute zero. Solve to 3 sig figs. (Show your set-up, circle your answer.)

g. The accepted value for absolute zero is T = -273.15 ºC. **What is your percent yield for this lab?** (Again, show your set-up and circle your answer.)