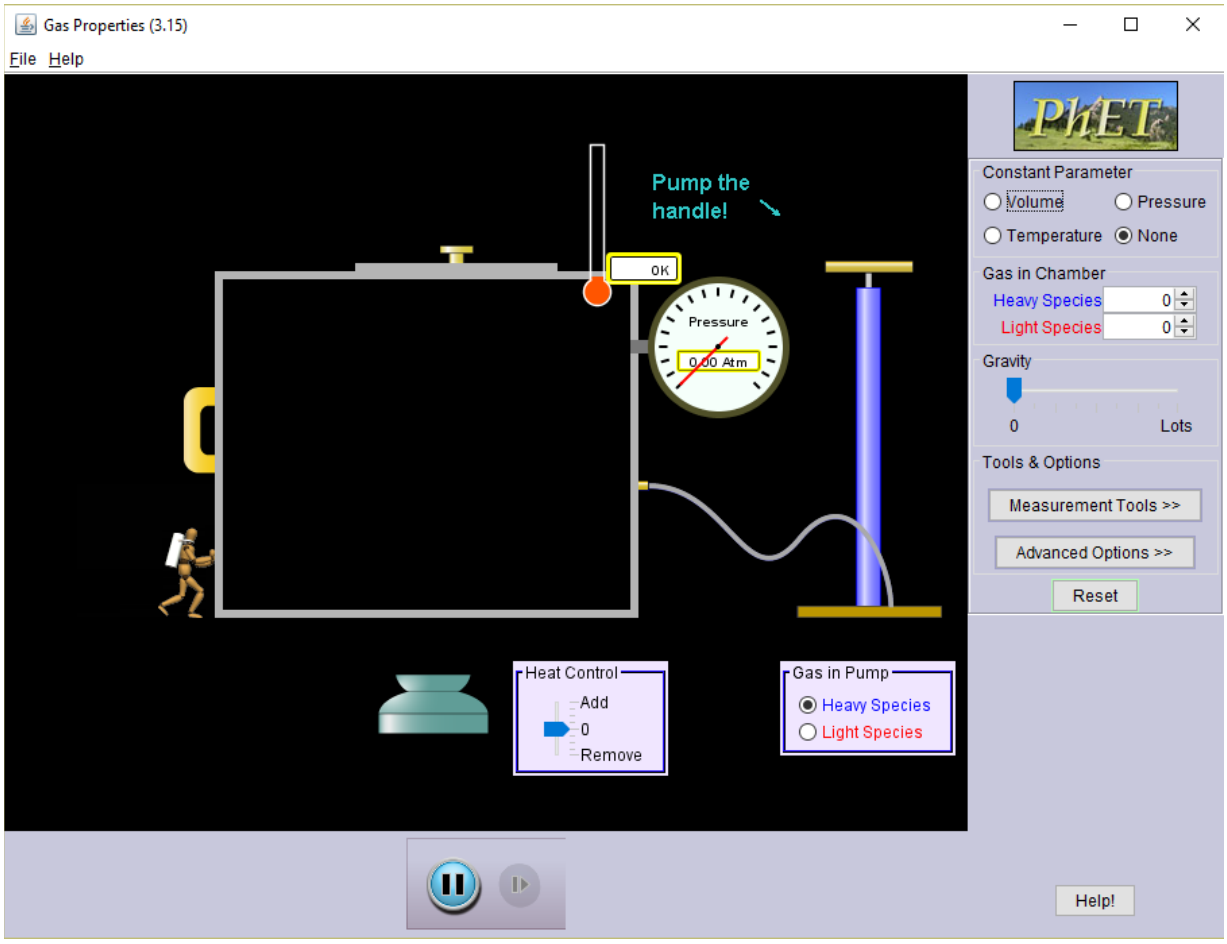
Gases and the Gas Laws

Lab Procedure – Answer the questions in red.

Download and run the Java application "gas-properties_en.jar". An image of the app screen appears below.

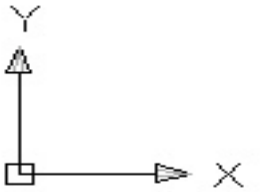
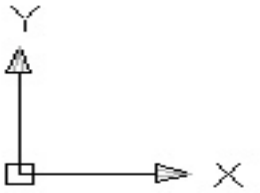
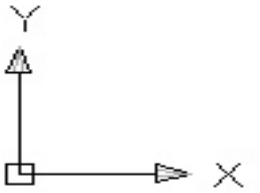
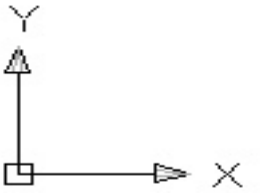


1. Click and drag the pump handle up and down and see what happens. Do it again. Notice also that you can vary the volume of the gas chamber by dragging the chamber using the handle on the left.

   You can also read out the temperature and pressure of your gas. You can also add heat to the gas by adjusting the "stove" below the gas chamber.

   Note that the number of particles (number of particles) is expressed in "moles" of particles.

2. Make a chart like the one below. You will not turn in the charts themselves. Without using the simulation, sketch what you think the graphs would look like. **Note: Be sure to label your x and y axes. Assume that other variables remain constant (for example, temperature and number of particles remains constant in the first graph).**

I. Pressure vs. Volume 	Explain your reasoning for the graph's appearance
II. Volume vs. Temperature 	Explain your reasoning for the graph's appearance
III. Pressure vs. Temperature 	Explain your reasoning for the graph's appearance
IV. Volume vs. Moles of Particles 	Explain your reasoning for the graph's appearance

a) Explain the appearance of each of your 4 charts either below or in the right-hand boxes of the chart above. In all charts, the first variable given (pressure in the first chart) is plotted on the y-axis.

b) Explain the reasoning behind your prediction for each chart.

3. For each case in your chart above, write a short description of how to use the simulation to collect data.

a) Pressure vs. volume.

b) Volume vs. temperature.

c) Pressure vs. temperature.

d) Volume vs. moles of particles.

4. Below, you will take actual measurements using the simulation. For each case explained below, take at least four measurements while changing one variable and recording the change in the other variable.

   Press the reset button. Add about 200 moles of gas (heavy species) to the chamber using the pump, then let pressure and temperature come to equilibrium. Select "None" in the constant parameters box

   a) What are the starting values for pressure and temperature you read?

Set temperature as a constant. Assume a starting volume of "40". Click "Measurement Tools" and select the ruler to help with estimating volume. Change the volume to three new values, and look at the resulting pressure. After each change, allow some time for the system to come to equilibrium.

If you blow the lid off the chamber, you will need to do a reset and start again.

   b) List the 4 values for pressure vs. volume you obtain (including your starting values as one of the four). Remember, you are changing volume, and recording the change in pressure. Temperature is constant.

   c) Can you identify a relationship between pressure and volume?

d) Reset. Select “none” in the constant parameter box. Add 200 moles of new gas. Let the system come to equilibrium. Now select pressure as your constant. Vary the temperature by adding heat from the heat control at the bottom. Try not to change the temperature by too much. Give time for the system to come to equilibrium after each change. List the 4 values you read for volume vs. temperature.

e) Can you identify a relationship between volume and temperature?

f) Reset. Select “none” in the constant parameter box. Add 200 moles new gas. Let the system come to equilibrium, then select volume as the constant. To change the temperature, just use the heat control at the bottom and add heat. The temperature should go up. List the 4 values you measure for pressure vs. temperature.

g) Can you identify a relationship between pressure and temperature?

h) Reset. Select “none” in the constant parameter box. Add 200 moles new gas. Let the system come to equilibrium, then select pressure as the constant. Use the pump to add gas to the chamber. Try not to add more than about 20 moles at a time. Estimate the volume changes as best you can from a starting value of 40 using the ruler tool. List the 4 values you measure for number of volume vs. moles.

i) Can you identify a relationship between volume and the number of moles of the gas?