Procedures for the Ideal Gas Law Exercise

Access the Thermodynamics animation developed by Professor Giambattista and read the Tutorial to understand how the animation works

PART I: Compressing a Gas in a Cylinder.

1. Place a check mark in the **Use Reservoir** box, but leave the **Lock Piston** box unchecked. This in effect keeps the temperature constant at 300 K for an isothermal situation and we let the pressure and volume change. Select Pressure for the Floating Graph
2. Slide the Position bar all the way to the right to change the volume of the gas from 5 to10. Record the pressure and volume in Table I.
3. Slide the volume bar to the left and change the volume from 10 to 5 (reduce the volume by a factor of ½). Record the Pressure and Volume in Table I.
4. Slide the volume bar to the left and change the Volume from 5 to 2.5 (reduce the volume by a factor of ½ again). Record the pressure and volume in Table I.
5. Slide the volume bar to the left and change the volume from 2.5 to 1.

Table I

Pressure (Pa)	Volume (m^3)	Temperature (K)	Pressure Change
		300	XXXXXXXXXXX
		300	
		300	
		300	XXXXXXXXXXX

Fill in the blanks:

When we held the temperature constant and cut the volume in half, each time we reduced the volume we observed that the pressure (increased/decreased) by a factor of (1 / 2 / 4 /8 / 10). Circle the correct answer.

When we held the temperature constant and reduced the volume from 10 to 1, we observed that the pressure (increased/decreased) by a factor of (1 / 2 / 4 / 8 / 10). Circle the correct answer.

PART II: Heating a Gas in an Expandable Cylinder

1. Keep the **Use Reservoir** button checked and the **Lock Piston** button still unchecked. Move the Position slider to 5.0 and then move the Temperature slider all the way to the left and move the Position sliders all the way to the left. Then slide the Position slide all the way to the left to 1.0. You should have a temperature of 100 K and volume of 1.0. The pressure should read 831 and stay constant for an isobaric process. Select Volume for the floating graph and click Clear Graph.
2. Slide the Temperature bar to the right to change the temperature of the gas from 100 to 200. (Use the slider bar to get close to 200 and then the arrows on either end of the slider bar change the temperature 0.1 degrees at a time) Record the Temperature and Volume in Table II.
3. Slide the Temperature bar to the right to change the temperature of the gas from 200 to 400. Record the Temperature and Volume in Table II.
4. Slide the Temperature bar to the right to change the temperature of the gas from 400 to 800. Record the Temperature and Volume in Table II.
5. Slide the Temperature bar to the right to change the temperature of the gas from 800 to 1000. Record the Temperature and Volume in Table II.

As you changed the reservoir's temperature, you also changed the temperature of the gas. As a result, the pressure exerted on the piston also changed.

Table II

Pressure (Pa)	Volume (m^3)	Temperature (K)	Volume Change
831			XXXXXXXXXXX
831			
831			
831			
831			XXXXXXXXXXX

When we held the pressure constant and double the temperature, each time we doubled the temperature we observed that the volume (increased/decreased) by a factor of (1 / 2 / 4 / 8 / 10). Circle the correct answer.

When we held the pressure constant and increased the temperature from 100 to 1000, we observed that the volume (increased/decreased) by a factor of (1 / 2 / 4 / 8 / 10). Circle the correct answer.

PART III: Heating a Gas in an Cylinder with Fixed Volume

1. Reset the Position slider to 5.0 and then check both the ***Use Reservoir*** and **Lock Piston** buttons, which in effect holds the volume constant at 5.0. Slide the Temperature bar all the way to the left for a Temperature reading of 100 K. Select Pressure for the Floating Graph.
2. Slide the Temperature bar to the right to change the temperature of the gas from 100 to 200. Record the Temperature and Pressure in Table III.
3. Slide the Temperature bar to the right to change the temperature of the gas from 200 to 400. Record the Temperature and Pressure in Table III.
4. Slide the Temperature bar to the right to change the temperature of the gas from 400 to 800. Record the Temperature and Pressure in Table III.
6. Slide the Temperature bar all the way to the right to change the temperature of the gas from 800 to 1000. Record the Temperature and Pressure in Table III.

Table III

Pressure (Pa)	Volume (m^3)	Temperature (K)	Pressure Change
	5		XXXXXXXXXXX
	5		166.2
	5		332.4
	5		664.8
	5		XXXXXXXXXXX

When we held the volume constant and doubled the temperature, each time we doubled the temperature we observed that the pressure (increased/decreased) by a factor of (1 / 2 / 4 / 8 / 10). Circle the correct answer.

When we held the volume constant and increased the temperature from 100 to 1000, we observed that the pressure (increased/decreased) by a factor of (1 / 2 / 4 / 8 / 10). Circle the correct answer.

PART IV: Compressing a Gas in an Cylinder, Ideal Gas Law and Molecular Activity

1. Remove the check marks in both the **Use Reservoir** and **Lock Piston** buttons and slide the Position slider to 10.0. This situation in effect replicates the Ideal Gas Law scenario such that when we change the volume (compress or decompress the gas) the temperature and pressure change in accordance with the equation PV = (a constant) T.

2. Select Molecular Act for the Floating Graph. You will see the activity of the molecules in the gas respond to the change in volume.
3. Slide the Position bar back and forth from left (compresses the gas) to right (decompresses the gas) and observe the molecular activity.

When we let the temperature, pressure and volume change in relation to each other and compressed the gas:

(a.) We observed that as we compress the gas (decrease the volume) the temperature (increased/decreased) and pressure (increased/decreased). Circle the correct answers.

(b.) We observed that as we compress the gas (decrease the volume) the molecules moved (faster/slower)   Circle the correct answer.

(c.) As we compressed the gas the temperature (increased/decreased) and kinetic energy of the molecules (increased/decreased) and the molecular activity (increased/decreased). Circle the correct answers.