

Name: \_\_\_\_\_

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



<b>STATES OF MATTER VIRTUAL LAB</b>
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This lab has been adapted from a lab submitted to PhET by Brother Lucien Blain ([brlucien@verizon.net](mailto:brlucien@verizon.net)) of Monsignor McClancy High School on 2/23/10 and updated on 3/1/10.

This lab is worth 14 points. The number of points earned on the lab (57 available) will be divided by four to determine your grade.

**Learning Goal:**

Students will be able to demonstrate their knowledge of the states of matter through illustrations and descriptions. These illustrations and descriptions should include:

- How the molecules in a solid, liquid and gas compare to each other.
- How temperature relates to the kinetic energy of molecules.

**Prediction:**

1. (3 points) Write a definition for each of the following:

Solid \_\_\_\_\_  
 \_\_\_\_\_

Liquid \_\_\_\_\_  
 \_\_\_\_\_

Gas \_\_\_\_\_  
 \_\_\_\_\_

2. (3 points) Draw an illustration for each of the following (for electronic submission, use the “Shapes” function of MS Word).

SOLID	LIQUID	GAS

**Procedure:**

1. Open the internet browser and enter the address: <http://phet.colorado.edu/en/simulation/states-of-matter>
2. Click on “Run Now”

3. (12 points) Complete the table below by exploring the “Solid, Liquid, Gas” tab in the simulation. Test your predictions and record your observations by recording the temperature and use the “Print Screenshot” function on your computer keyboard to paste the screen picture. Use the “Crop” function to eliminate unnecessary parts, then size to fit just the size of the substance and the size of the box.

Substances	Observations		
	Solid	Liquid	Gas
<b>Neon</b>	Temperature: Illustration/Description:	Temperature: Illustration/Description:	Temperature: Illustration/Description:
<b>Argon</b>	Temperature: Illustration/Description:	Temperature: Illustration/Description:	Temperature: Illustration/Description:
<b>Oxygen</b>	Temperature: Illustration/Description:	Temperature: Illustration/Description:	Temperature: Illustration/Description:
<b>Water</b>	Temperature: Illustration/Description:	Temperature: Illustration/Description:	Temperature: Illustration/Description:

4. (2 points) Compare the differences between the solid and liquid diagrams of water to the solid and liquid diagrams of the other molecules. How is water different than the others?

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5. (5 points) Sketch a graph of Kinetic Energy vs. Temperature. Label the axes and include units, but no numerical values are needed, just a sketch. Use this graph to describe the relationship between the two concepts on the next page.

6. (2 points) How do the molecules in a solid, liquid and gas compare to each other?

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7. (2 points) How temperature relates to the kinetic energy of molecules.

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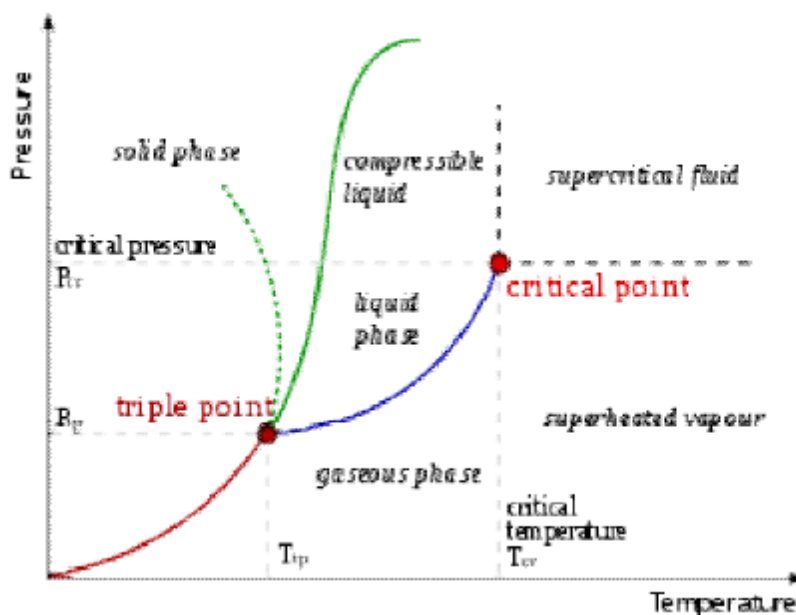
8. (2 points) Explain how a change in temperature affects the pressure inside a container.

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9. (3 points) Explain the phase diagram below by relating what you know about temperature, states of matter, and pressure.



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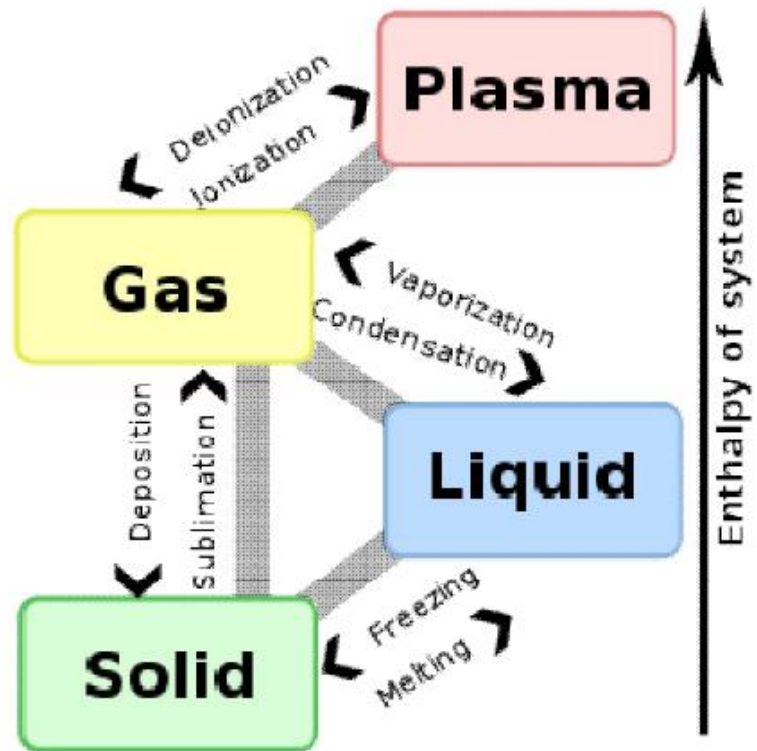
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At the triple point, all three phases can coexist. In the diagram, the line between the triple point and the critical point is marking the boundary between liquid and gas does not continue indefinitely, but terminates at a point called the critical point. As the temperature and pressure approach the critical point, the properties of the liquid and gas become progressively more similar. At the critical point, the liquid and gas

become indistinguishable. Above the critical point, there are no longer separate liquid and gas phases: there is only a generic fluid phase referred to as a supercritical fluid.

### Interfacial phenomena

Between two phases in equilibrium there is a narrow region where the properties are not that of either phase. Although this region may be very thin, it can have significant and easily observable effects, such as causing a liquid to exhibit surface tension. In mixtures, some components may preferentially move toward the interface. In terms of modeling, describing, or understanding the behavior of a particular system, it may be efficacious to treat the interfacial region as a separate phase.



10. (8 points) Fill in the table below using the “Phase Changes” tab of the simulation
  - a. Starting with the initial situation, state the following for each:
    - i. Temperature
    - ii. Pressure
    - iii. Movement of molecules
    - iv. Distance between molecules (tight, loose, random)
  - b. Add heat until at least 8 molecules begin to freely move around. Press pause and fill in the second column.
  - c. Press play and push down on the lid until it is slightly above the hose for the pump. Pause and fill in the information in the third column.
  - d. Press play and do 10 complete pumps with the handle of the pump. Each pump will add 4 molecules of the substance. Pause and fill in the fourth column of the chart.
  - e. Repeat steps a – d for each of the other gases. Remember to first click the Reset All button.

Substances	Observations			
	Initial Sample	Heat added to some molecules moving freely	Lid pushed down	After 10 pumps
Neon	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:
Oxygen	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:
Water	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:	Temperature: Pressure: Movement: Distance:

11. (2 points) Choose one of the gases and remove the heat. Describe below the effect it has on the molecules.

Gas tested \_\_\_\_\_

Effect \_\_\_\_\_

\_\_\_\_\_

**Questions:**

1. (2 points) State in words and formula the Ideal Gas Law.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. (2 points) What state is the matter in which all molecules are just vibrating around?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. (2 points) Why do some molecules begin sticking together when you add in more molecules?

\_\_\_\_\_

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4. (2 points) State the difference between heat and thermal energy.

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5. (2 points) State the difference between heat and temperature.

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**The answers on this lab are a product of my own work and effort. Though I may have received some help in understanding the concepts and/or requirements, I did the work myself.**

\_\_\_\_\_  
**Student Signature (for electronic submission, type student number in lieu of signature)**

**ROOM FOR IMPROVEMENT**

**APPLICABILITY:** This lab is best suited for (check all that apply):

- Physics I Honors/ Pre-IB Physics     IB Physics 2     IB Physics 3     None of These

**IMPROVEMENT:** This lab can be improved by:

When complete, upload to FOCUS  
Ensure your filename is "FirstInitialLastNamePerXLabName"