Simulation 10.1a

PhET States of Matter Simulation

Name: _____

Date: _____ Per: _____

DIRECTIONS: Open the PhET States of Matter simulation using the link from the instructor's website.

Part A: States

Select the "States" button at the bottom of the window. Reset the simulation (↻).

1. Explain the difference in the diagrams of the 4 species available for study (neon, argon, oxygen and water). _____

2. Change the **Atoms & Molecules** setting to *Neon*. Draw neon as a solid, liquid, and gas.

Solid	Liquid	Gas

3. *Reset the simulation (↻).* Change the **Atoms & Molecules** setting to *Neon*. Change the **State** setting to liquid. Explain the particles of neon that separate from the larger group of particles. _____

4. Change the **Atoms & Molecules** setting to *Oxygen*. Describe the change in motion as heat is added to the system. _____

5. Change the **Atoms & Molecules** setting to *Water*. Change the **Temperature** setting to *Celsius degrees*. Using water, click through the three states and explain the changes in temperature at each state. _____

6. Lower the temperature to -270ºC. Describe the arrangement of the particles. How are the atoms within the water molecules aligned with atoms in adjacent water molecules? _____

7. Change the **Atoms & Molecules** setting to *Oxygen*. Examine the motion of oxygen in the gas state. Describe the motions of the particles. _____

   a. How do the particles move past one another? _____

   b. At a given temperature describe the speed of the particles. _____

   c. Which molecules are most active in their solid state? _____

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Part B: Interactions

Select the "Interaction" button at the bottom of the window. Reset the simulation (↻).

1. Describe the graph. Compare the graphs for neon and argon. Why is the value marked "ε" larger for argon than neon? _____

2. Put the simulation in slow motion. Expand the **Forces** menu. Change the **Forces** setting to *Attractive/Repulsive*. Drag the unpinned particle a short distance away from the pinned particle. How do the attractive forces and repulsive forces change as the particles approach one another? _____

3. Change the **Atoms** setting to *Argon*. Change the ***Forces*** setting to *Total Force*. Drag the unpinned particle a short distance away from the pinned particle. Explain the variations in the *Total Force* as the argon atoms approach one another. _____

4. *Reset the simulation (↻).* Change the **Atoms** setting to *Adjustable Attraction*. Change the **Interaction Strength** and note how the change affects the depth of the trough on the graph. Why is the potential energy lower when atoms with higher interaction strengths become close? _____

5. What does the graph mean in terms of relationship between distance and potential energy? _____

6. Why do particles collide? _____

7. Why are some particles more repulsive than others? _____

Part C: Phase Changes

Select the "Phase Changes" button at the bottom of the window. Reset the simulation (↻).

1. With the **Atoms & Molecules** setting on Neon, determine what changes are necessary to cause a change in the state of the neon. Explain how those factors change the state of the neon. _____

2. Reset the simulation (↻). Lower the lid of the container until the particles change phase. Note the pressure as the lid is lower. When does the pressure start to increase? Why? _____

3. Reset the simulation (↻). Change the **Atoms & Molecules** setting to *Oxygen*. Pump oxygen into the chamber. Why does the additional oxygen cause the oxygen to undergo a phase change? _____

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Part D: Phase Diagrams

Select the "Phase Changes" button at the bottom of the window. Reset the simulation (↻).

1. Change the **Atoms & Molecules** setting to *Water*. Change the **Temperature** setting to *Celsius degrees*. Note the position of the red dot on the *Phase Diagram.* Increase the pressure of the system and describe how the red dot moves. _____

   a. Why does the red dot never leave the black lines on the phase diagram? _____

2. *Reset the simulation (↻).* Change the **Atoms & Molecules** setting to *Adjustable Attraction*. Change the **Temperature** setting to *Celsius degrees*. Raise the temperature of the sample until it is approximately −180°C. Note the appearance of the particles. Adjust the *Interaction Strength* from *strong* to *weak* and note the changes in the system. Explain why changing the interaction strength caused the observed change. _____