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## Answer Key: Stranger Things than Matter: 7th Grade Molecular Mystery

Calculate molar volume transitions and analyze kinetic molecular theory to predict how non-Newtonian fluids and supercritical fluids defy standard phase boundaries.

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**1. A sample of Gallium melts in your hand at 29.7°C. While it is transitioning from solid to liquid, what happens to the average kinetic energy of the molecules?**

**Answer:** B) It remains constant as energy is used to overcome intermolecular forces.

During a phase change, the temperature remains constant; therefore, the average kinetic energy does not change. The added thermal energy serves as potential energy to break the bonds or attractive forces holding the solid lattice together.

**2. In a laboratory, a scientist observes Iodine crystals turning directly into a purple vapor without becoming liquid. This endothermic process is called \_\_\_\_\_.**

**Answer:** C) Sublimation

Sublimation occurs when the vapor pressure of a substance is high enough that it skips the liquid phase entirely when energy is added, as seen with solid Iodine or Dry Ice.

**3. True or False: According to the Kinetic Molecular Theory, the particles in a Gill-sized sample of Neon gas at 100°C are in constant, random motion and have perfectly elastic collisions.**

**Answer:** A) True

The Kinetic Molecular Theory postulates that gas particles are in continuous motion and their collisions result in no net loss of total kinetic energy (elasticity).

**4. Which of the following scenarios best illustrates the concept of 'Deposition' in a natural environment?**

**Answer:** B) Sub-zero water vapor forming intricate frost patterns on a cold windshield.

Deposition is the phase transition where a gas transforms directly into a solid. Frost is the result of water vapor in the air losing thermal energy rapidly upon contact with a freezing surface.

**5. If you increase the pressure on a gas while keeping the temperature constant, the \_\_\_\_\_ will decrease as the particles are forced closer together.**

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**Answer:** B) Volume

According to Boyle's Law, pressure and volume are inversely proportional in gases. Increasing pressure reduces the empty space between gas molecules.

**6. True or False: Amorphous solids, such as glass or pitch, possess a highly regular, repeating geometric crystalline lattice structure.**

**Answer:** B) False

Amorphous solids lack the long-range order and defined repeating patterns found in crystalline solids; their particles are arranged more randomly, similar to a 'frozen' liquid.

**7. In a 'Supercritical Fluid' state, a substance like Carbon Dioxide exhibits which of the following unique behaviors?**

**Answer:** B) It possesses the density of a liquid but the ability to effuse through solids like a gas.

Supercritical fluids occur beyond the critical point of temperature and pressure, merging the properties of liquids (density/solvency) and gases (low viscosity/diffusion).

**8. Viscosity is a measure of a liquid's resistance to flow. As the temperature of a liquid like honey increases, its viscosity typically \_\_\_\_\_.**

**Answer:** B) Decreases

Increasing temperature provides molecules with enough kinetic energy to overcome the intermolecular forces of attraction, allowing the liquid to flow more easily (lower viscosity).

**9. True or False: Evaporation can only occur when a liquid reaches its specific boiling point throughout the entire volume of the substance.**

**Answer:** B) False

Evaporation is a surface phenomenon that can occur at any temperature, as high-energy molecules at the surface escape into the gas phase. Boiling occurs when the vapor pressure equals the atmospheric pressure throughout the liquid.

**10. Why does water expand when it freezes into ice, unlike most other substances that contract?**

**Answer:** B) Hydrogen bonding creates a hexagonal crystalline structure with more empty space between molecules.

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Due to the polarity of water, hydrogen bonds force the molecules into a specific open-lattice hexagonal shape as they freeze, making ice less dense than liquid water.