

Name: KEY Period: A,B,C,F,G Date: 5/1/15

Model of an ideal gas Unit 10 Test Review: States of Matter

Part A: Kinetic Molecular Theory

Complete each statement.

*base on* → particles of matter are always in motion

*Gases are more ideal at very high Temp and very low Pressures!*

- The kinetic molecular theory describes the behavior of gases in terms of particles in motion.
- The kinetic molecular theory makes the following assumptions.
  - In a sample of a gas, the volume of the gas particles themselves is very small compared to the volume of the sample. → *1000 times greater than their volume as a lig. solid.*
  - Because gas particles are far apart, there are no significant attractive or repulsive forces between gas particles.
  - Gas particles are in constant and rapid random motion.
  - The collisions between gas particles are elastic; that is, no Kinetic energy is lost.
- Temperature is a measure of the average kinetic energy of the particles in a sample of matter.
- At -273 °C, or 0 K, particles have no kinetic energy and motion stops.
- Kinetic energy and Kelvin temperatures are directly proportional.
- Which gas has the greatest kinetic energy of particles?
  - N<sub>2</sub> gas at 400°C
  - H<sub>2</sub>O vapor at 350°C
  - H<sub>2</sub> gas at 325°C
  - HCl gas at 20°C

$$KE = \frac{1}{2}mv^2$$

*Average speeds and kinetic energies of gas particles increases with an increase in temperature and decrease with a decrease in temp.*  
*All gases at the same temp. have the same KE. So... at the same TEMP lighter gas particles have higher speeds than heavier gas particles*

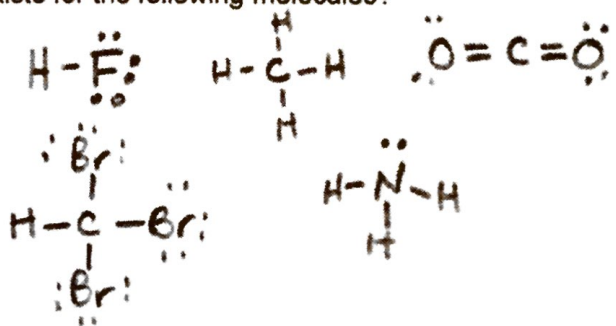
For each statement below, write true or false.

- TRUE 6. Gases are less dense than solids because there is a lot of space between the particles of a gas.
- TRUE 7. The random motion of gas particles causes a gas to expand until it fills its container.
- FALSE 8. Gas particles can be compressed because they are so small.

**Part B: Intermolecular Attractive Forces (IMF's)**

- London dispersion forces are caused by the continuous motion of electrons. They are the weakest strongest intermolecular attractive force. They are the main IMAF between polar nonpolar molecules.
- Dipole-dipole forces exist between polar molecules. They are stronger than London dispersion forces, but weaker than hydrogen bonding. They occur when the partially charged atom on one molecule is attracted to a partially charged atom on a nearby molecule.
- Hydrogen bonding occurs when a hydrogen atom on one molecule is attracted to an unshared pair of electrons on a very electronegative atom of a nearby molecule. In order to hydrogen bond, molecules must contain hydrogen bonded to fluorine, oxygen, or nitrogen. H-bonding is the weakest / strongest IMF.
- List three properties of water that are due to hydrogen bonding.  
liquid at room Temp., expands in volume when it freezes → less dense as a solid, high boiling point
- What is the main intermolecular attractive force that exists for the following molecules?

HF	<u>hydrogen bonding</u>
CHBr <sub>3</sub>	<u>polar - Dipole - Dipole</u>
CH <sub>4</sub>	<u>London dispersion</u>
NH <sub>3</sub>	<u>dipole-dipole hydrogen</u>
CO <sub>2</sub>	<u>London dispersion</u>



- Intermolecular attractions are stronger / weaker than the strengths of ionic bonds and covalent bonds (intramolecular attractions).
- Identify which of the changes below require breaking intermolecular attractions and which require breaking intramolecular attractions.
 

A. NH <sub>3</sub> (g) → N <sub>2</sub> (g) + H <sub>2</sub> (g)	<u>intra</u>
B. H <sub>2</sub> O(s) → H <sub>2</sub> O(g)	<u>inter</u>
C. CaCl <sub>2</sub> (s) → Ca(s) + Cl <sub>2</sub> (g)	<u>intra</u>
D. Br <sub>2</sub> (l) → Br <sub>2</sub> (g)	<u>inter</u>

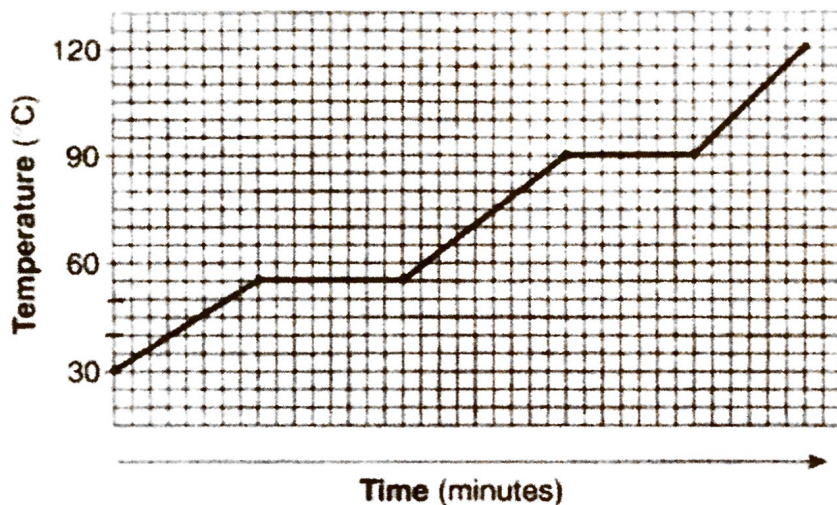
8. Higher melting and boiling points are caused by stronger IMAF's / stronger chemical bonds.  
**BOTH**

9. Circle the substance that would have the higher boiling point.

- a) H<sub>2</sub>O or H<sub>2</sub>S
- b) HF or H<sub>2</sub>
- c) NH<sub>3</sub> or NO<sub>2</sub>

### Part C: Heating Curves

- 1. What is heat? energy transferred between objects at dif. temperatures
- 2. Melting, vaporization, and sublimation are endothermic / exothermic changes. They absorb / release energy.
- 3. What are the three phase changes that result in the distances between the particles decreasing?  
condensing , freezing , deposing
- 4. The graph below represents the heating curve of a substance that starts as a solid below its freezing point.



- a) What is the melting point of the substance? 55°C
- b) What is the boiling point of the substance? 90°C
- c) What is the temperature range where the substance is a solid? 30° → 55°C
- d) What is the temperature range where the substance is a liquid? 55°C → 90°C
- e) What is the temperature range where the substance is a gas? 90°C → 120°C
- 5. What happens to the temperature of a substance when it changes state?  
It increases / decreases / stays the same
- 6. What type of energy is changing during a change of state? Kinetic / Potential

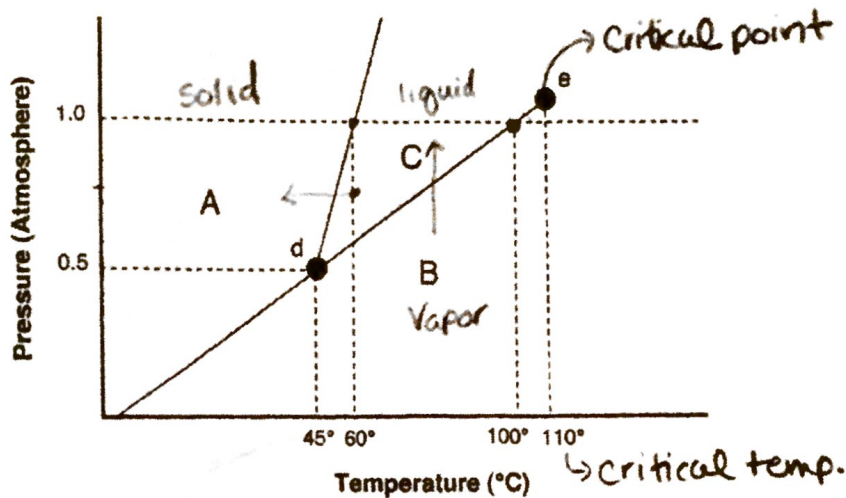
7. During a change of state, the energy being absorbed is used to make the molecules move faster / separate the molecules (circle answer)

8. The heat of vaporization is the energy required for a substance to melt / vaporize • molar enthalpy of vaporization

9. The heat of fusion is the energy required for a substance to freeze • molar enthalpy of fusion

**Part D: Phase Diagrams**

Answer the questions below in relation to the following generic phase diagram.



- Which section represents the solid phase? A
- What section represents the liquid phase? C
- What section represents the gas phase? B
- What letter represents the triple point? d What is the definition of a triple point?  
The T.P. indicates the T+P conditions at which the substance can exist as a solid, liquid, + gas
- What is this substance's normal melting point, at 1 atmosphere of pressure? 60°C
- What is this substance's normal boiling point, at 1 atmosphere of pressure? 100°C
- Above what temperature is it impossible to liquefy this substance, no matter what the pressure?  
110°C
- At what temperature and pressure do all three phases coexist? 45°C 0.5 atm
- A sample of the substance is held constant at a temperature of 80°C, while the pressure is increased from 0.6 atm to 1.0 atm. What phase change occurs? condensation
- The phase change from A to B is called sublimation
- A sample of the substance is held constant at a pressure of 0.75 atm while the temperature is decreased from 60°C to 30°C. The phase change that occurs is freezing