

NAME \_\_\_\_\_ PERIOD \_\_\_\_\_ DATE \_\_\_\_\_

### CHANGES OF STATE UNIT 10 - PART 3

➤ ALSO USE MODERN CHEMISTRY P. 372-382 ORANGE, 343-348 BLUE TEXT

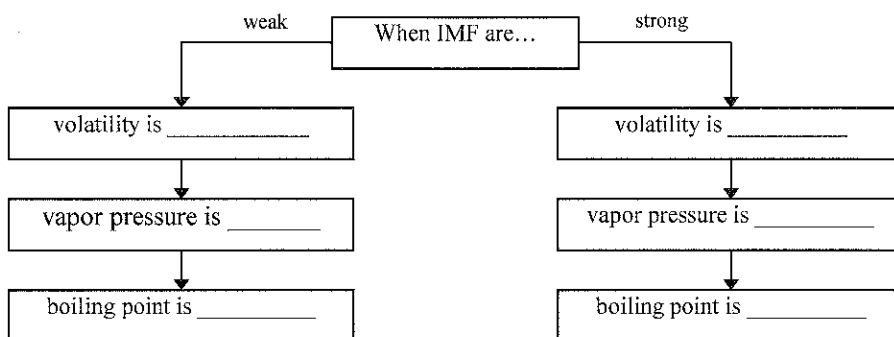
- GO TO <http://msrobbinspnhs.weebly.com/> AND CLICK ON THE CHEMISTRY NOTES PAGE.
- SCROLL DOWN TO UNIT 10 AND DOWNLOAD THE phasechange\_pres.ppt button.
- AS YOU **STUDY** THE POWERPOINT TAKE NOTES BELOW → INCLUDE DIAGRAMS



### PART 3 PRACTICE

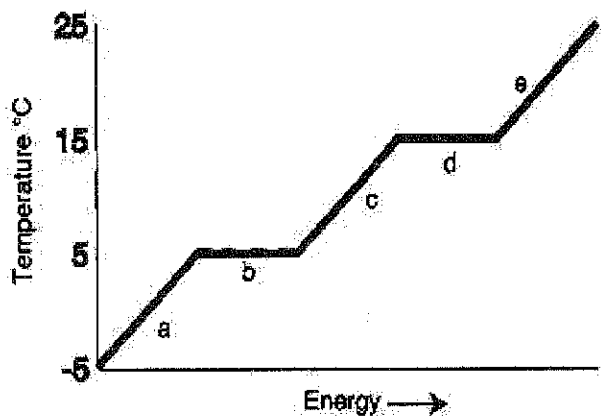
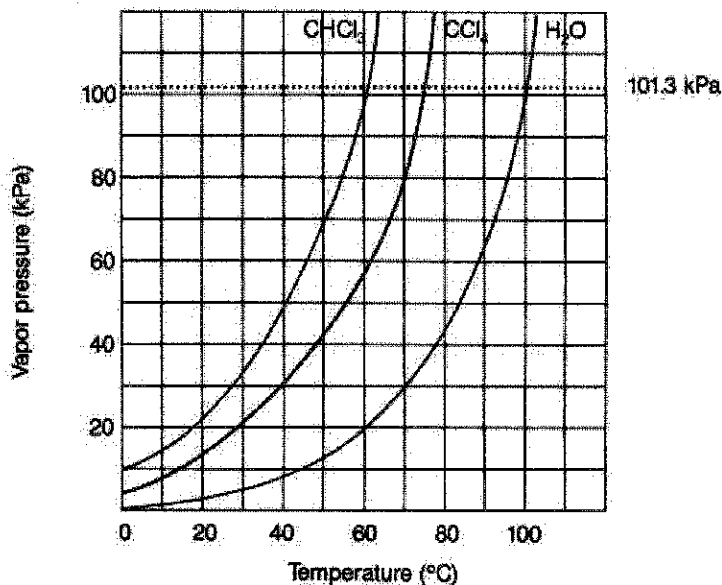
#### PART A - INTERMOLECULAR FORCES

- Fill in the diagram (with high or low) to show how *intermolecular forces* influence the volatility, vapor pressure, and boiling point of a substance.



**PART B - VAPOR PRESSURE GRAPHS** Use the graph to the right to answer the following questions.

- What is the vapor pressure of  $\text{CHCl}_3$  at  $50^\circ\text{C}$ ? \_\_\_\_\_
- What is the boiling point of  $\text{H}_2\text{O}$  when the external pressure is 30 kPa? \_\_\_\_\_
- What is the normal boiling point of  $\text{CCl}_4$ ? \_\_\_\_\_
- Which substance has the weakest IMF? \_\_\_\_\_

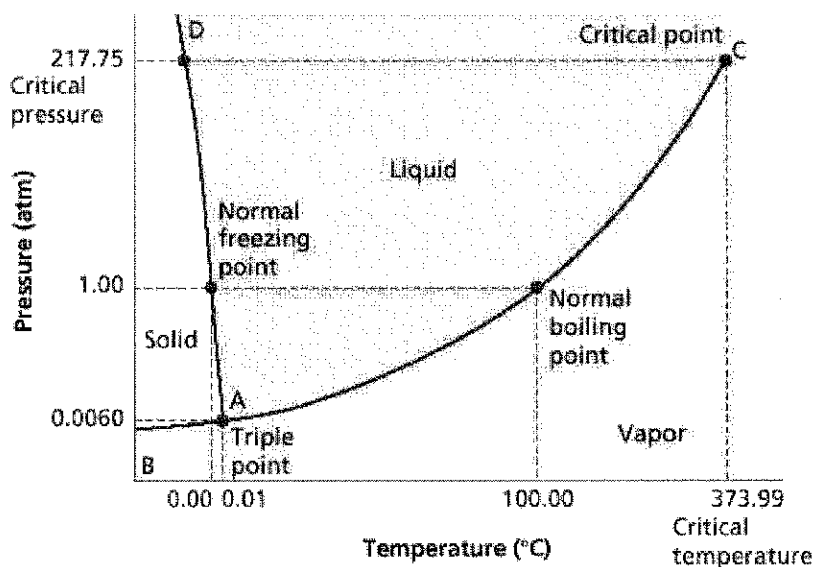


**PART C - HEATING CURVES.** Use the heating curve to the left to answer the following questions.

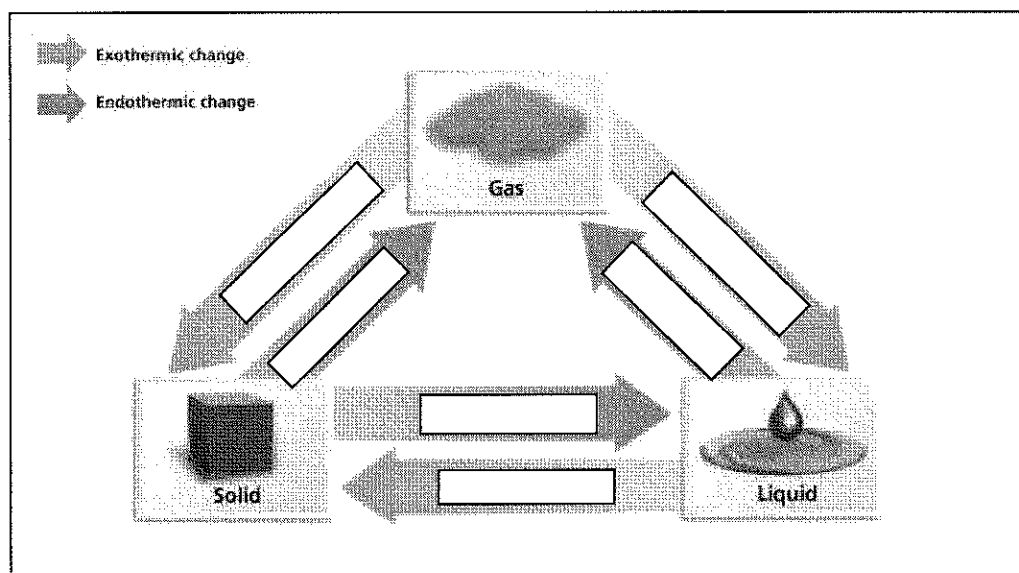
- What is the melting point of the substance? \_\_\_\_\_
- What is the boiling point of the substance? \_\_\_\_\_
- Which letter represents heating of the solid? \_\_\_\_\_
- Which letter represents heating of the vapor? \_\_\_\_\_
- Which letter represents melting of the solid? \_\_\_\_\_
- Which letter represents boiling of the liquid? \_\_\_\_\_

**PART D - PHASE DIAGRAMS.** Use the phase diagram for water below to answer the following questions.

12. What is the state of water at 2 atm and 50° \_\_\_\_\_
13. What phase change will occur if the temperature is lowered from 80°C to -5°C at 1 atm? \_\_\_\_\_
14. You have ice at -10°C and 1 atm. What could you do in order cause the ice to sublime?  
\_\_\_\_\_
15. How could you lower the boiling point of water? \_\_\_\_\_



16. Describe each phase change on the correct arrow in the diagram below:



17. Go to page 348 in the blue Modern Chemistry book or on each station computer's desktop and answer question #7

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

### Unit 10 Test Review: States of Matter

#### Part A: Kinetic Molecular Theory

Complete each statement.

1. The kinetic molecular theory describes the behavior of gases in terms of particles in \_\_\_\_\_.
2. The kinetic molecular theory makes the following assumptions.
  - a) In a sample of a gas, the volume of the gas particles themselves is very \_\_\_\_\_ compared to the volume of the sample.
  - b) Because gas particles are far apart, there are no significant attractive or repulsive \_\_\_\_\_ between gas particles.
  - c) Gas particles are in constant and \_\_\_\_\_ motion.
  - d) The collisions between gas particles are \_\_\_\_\_; that is, no \_\_\_\_\_ energy is lost.
3. \_\_\_\_\_ is a measure of the average kinetic energy of the particles in a sample of matter.
4. At \_\_\_\_\_ °C, or \_\_\_\_\_ K, particles have no kinetic energy and motion stops.
5. Kinetic energy and Kelvin temperatures are \_\_\_\_\_ proportional.
6. Which gas has the greatest kinetic energy of particles?
  - A. N<sub>2</sub> gas at 400°C
  - B. H<sub>2</sub>O vapor at 350°C
  - C. H<sub>2</sub> gas at 325°C
  - D. HCl gas at 20°C

For each statement below, write *true* or *false*.

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

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

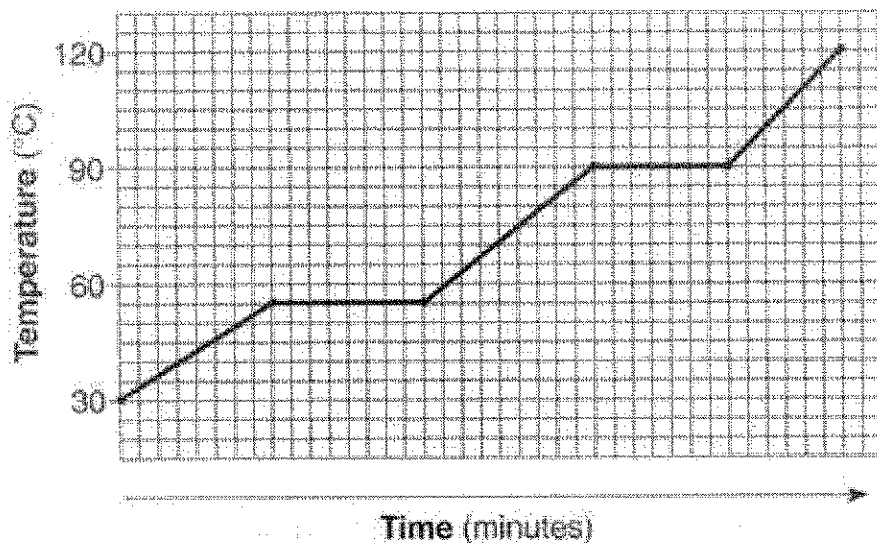
1. London dispersion forces are caused by the \_\_\_\_\_ of electrons. They are the weakest / strongest intermolecular attractive force. They are the main IMAF between polar / nonpolar molecules.
2. Dipole-dipole forces exist between \_\_\_\_\_ molecules. They are stronger than \_\_\_\_\_ forces, but weaker than \_\_\_\_\_. They occur when the partially \_\_\_\_\_ atom on one molecule is attracted to a partially \_\_\_\_\_ atom on a nearby molecule.
3. Hydrogen bonding occurs when a \_\_\_\_\_ atom on one molecule is attracted to an unshared pair of \_\_\_\_\_ on a very \_\_\_\_\_ atom of a nearby molecule. In order to hydrogen bond, molecules must contain hydrogen bonded to \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_. H-bonding is the weakest / strongest IMF.
4. List three properties of water that are due to hydrogen bonding.  
\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_
5. What is the main intermolecular attractive force that exists for the following molecules?  
HF \_\_\_\_\_  
CHBr<sub>3</sub> \_\_\_\_\_  
CH<sub>4</sub> \_\_\_\_\_  
NH<sub>3</sub> \_\_\_\_\_  
CO<sub>2</sub> \_\_\_\_\_
6. Intermolecular attractions are stronger / weaker than the strengths of ionic bonds and covalent bonds (intramolecular attractions).
7. Identify which of the changes below require breaking intermolecular attractions and which require breaking intramolecular attractions.  
A.  $\text{NH}_3(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{H}_2(\text{g})$  \_\_\_\_\_  
B.  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{g})$  \_\_\_\_\_  
C.  $\text{CaCl}_2(\text{s}) \rightarrow \text{Ca}(\text{s}) + \text{Cl}_2(\text{g})$  \_\_\_\_\_  
D.  $\text{Br}_2(\text{l}) \rightarrow \text{Br}_2(\text{g})$  \_\_\_\_\_
8. Higher melting and boiling points are caused by stronger IMAF's / stronger chemical bonds.

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

- a)  $\text{H}_2\text{O}$  or  $\text{H}_2\text{S}$
- b)  $\text{HF}$  or  $\text{H}_2$
- c)  $\text{NH}_3$  or  $\text{NO}_2$

**Part C: Heating Curves**

- 1. What is heat? \_\_\_\_\_
- 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?  
\_\_\_\_\_
- 4. The graph below represents the heating curve of a substance that starts as a solid below its freezing point.

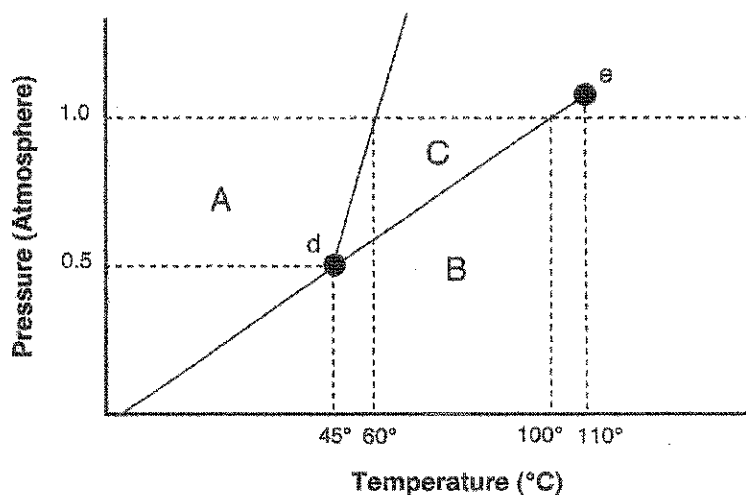


- a) What is the melting point of the substance? \_\_\_\_\_
- b) What is the boiling point of the substance? \_\_\_\_\_
- c) What is the temperature range where the substance is a solid? \_\_\_\_\_
- d) What is the temperature range where the substance is a liquid? \_\_\_\_\_
- e) What is the temperature range where the substance is a gas? \_\_\_\_\_
- 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

- During a change of state, the energy being absorbed is used to make the molecules move faster / separate the molecules. (circle answer)
- The heat of vaporization is the energy required for a substance to melt / vaporize.
- The heat of fusion is the energy required for a substance to \_\_\_\_\_.

### Part D: Phase Diagrams

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



- Which section represents the solid phase? \_\_\_\_\_
- What section represents the liquid phase? \_\_\_\_\_
- What section represents the gas phase? \_\_\_\_\_
- What letter represents the triple point? \_\_\_\_\_ What is the definition of a triple point?  
\_\_\_\_\_
- What is this substance's normal melting point, at 1 atmosphere of pressure? \_\_\_\_\_
- What is this substance's normal boiling point, at 1 atmosphere of pressure? \_\_\_\_\_
- Above what temperature is it impossible to liquefy this substance, no matter what the pressure?  
\_\_\_\_\_
- At what temperature and pressure do all three phases coexist? \_\_\_\_\_
- 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? \_\_\_\_\_
- The phase change from A to B is called \_\_\_\_\_.
- 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 \_\_\_\_\_.