Name _____ Date _____ Grade _____

Work Session 12: Intermolecular Forces

1. Distinguish between intermolecular and intramolecular forces. The term: "supramolecular bonding" is often used to describe one these forces. Which one? Explain why.

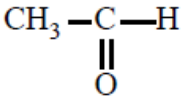
2. When water boils, which of the forces mentioned in question 1 is being broken? When an electric current is run into water, electrolyzing water into H_2 and O_2, which of these forces are being broken?

3. From the summary of intermolecular forces in the text, calculate the average energy for each of the five intramolecular forces. The average for ionic bonding is roughly 2200 kJ/mol. From these numbers, make a generalization about the energy required to separate molecules (as in boiling) to the energy required to disassociate ionic substances (as in electrolysis).

4. Given a large intermolecular force for one molecule, and a small intermolecular force for another molecule, which substance would have the higher boiling point? Why?

5. In solid NaCl, there is one kind of force holding the crystal together. In solid H_2O, there are two kinds of forces within the crystal. Identify the forces and explain.

6. Identify the intermolecular forces holding the following molecules together in the solid state:

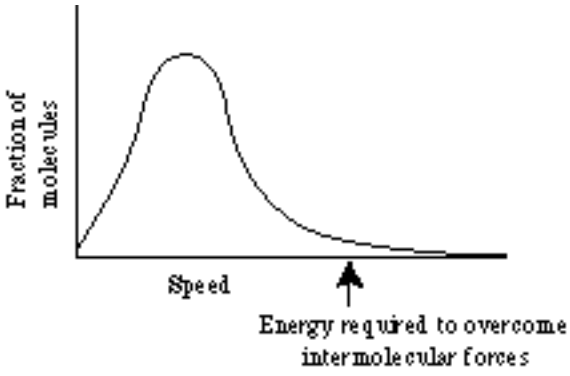
CH_3NH_2 F_2 NOF  C_2H_6 H_2O

7. Arrange the molecules in question 6 in order of increasing boiling point. Justify the order you chose.

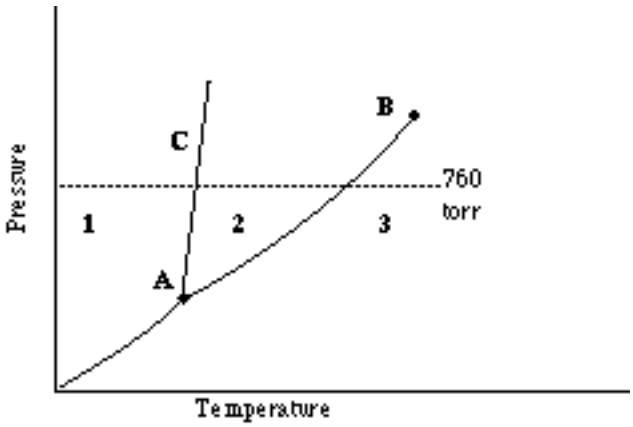
8. A simple cubic crystalline solid contains 48% empty space. A body centered crystalline solid contains 32% empty space. A face centered crystalline solid contains 26% empty space. Use simple drawings to explain why this is so. Answer on a separate sheet.

9. As a gas is cooling, the E_K of the molecules is decreasing. At the condensation point, however, the temperature remains constant as the gas condenses to a liquid. Heat is released, and yet the E_K stays the same. Explain this statement (see page 424 in the textbook). Answer on a separate sheet.

10. Below is a Maxwell-Boltzmann curve for the distribution of energy among the molecules of a substance at a particular temperature. Indicate with shading which of the molecules would have sufficient energy to evaporate. Redraw the curve on the same axis for a higher temperature. Indicate which molecules under the new curve have sufficient energy to evaporate. Use these curves and the size of the shaded areas to explain why a liquid has a higher vapor pressure at a higher temperature. Also, in which direction would the arrow be moved for a substance with a larger ΔH_{vap} than the substance shown? Explain.



11. For the phase diagram shown answer the following questions. What does point A represent? Point B? What is line C? From the direction of tilt of line C, is the solid more or less dense than the liquid? What is line AB? What happens to a substance taken from point 1 to 2 to 3? Where on the graph would the supercritical fluid state be? Put a mark on the x axis at the normal boiling point of the substance.



12. What elements can be added to silicon to produce an n-type semiconductor? A p-type semiconductor? What is this process called? What does it do to the crystal? Answer on a separate sheet.