

Lesson 17: Condensed Phases, Phase Changes, Water

text: 222-240

handout: Types of interactions

what to know:

- condensed phases, types of intermolecular forces and examples, §6-1, webout
- how the kinetic theory and intermolecular forces of liquids and solids relate to phase changes and the solubilities of various substances, §6-2, §6-3, §6-4
- vapor pressure and related terms, §6-3
- phase changes and related terms, §6-4
- structure of water and it determines its properties such as density, boiling point, melting point, surface tension, solubilizing ability, capillary action, conductance, specific heat, heat of vaporization, §6-4

questions:

1. Which of the following statements are true?
 - a. Molecular substances have relatively higher melting points than ionic substances.
 - b. As a rule, intermolecular forces are weaker than intramolecular (covalent) forces.
 - c. The fact that He can be liquefied is evidence that dispersion forces exist.
 - d. Dispersion forces are due to the attraction between temporary dipoles.
 - e. ICl has a higher boiling point than Br₂ because ICl is more polar.
 - f. The dispersion forces in N₂ are stronger than those in O₂.
 - g. The unusually high boiling point of HF results from the unusually strong type of dipole force called a "hydrogen bond".
 - h. The boiling point of ethyl alcohol(CH₃CH₂OH) is higher than that of dimethyl ether (CH₃OCH₃).
 - i. Methane (CH₄) is more soluble in benzene (C₆H₆) than in water.
 - j. The relative densities of liquid water and ice are explained by the way they hydrogen bond.
 - k. The fact that the O-H bond energy is much greater than the hydrogen bonding in water explains why it is much easier to melt ice than to decompose water into its elements.
 - l. The polar nature of water explains the water solubility of many ionic compounds.
2. When evaporation occurs from a liquid, what happens to the average kinetic energy of the remaining liquid? What effect does this have on the temperature of the remaining liquid?
3. What type of intermolecular forces are involved in: liquid helium? ice? Na⁺(aq), O₂(aq)
4. In each group, rank the compounds in order of those which would exhibit the greatest hydrogen bonding to the least.
 - a. HF, HI, HBr
 - b. H₂S, H₂O, NH₃
 - c. ether (CH₃OCH₃), ethyl alcohol (CH₃CH₂OH)
5. Explain in terms of forces between structural units why:
 - a. ICl has a higher melting point than Br₂ and Br₂ has a higher boiling point than Cl₂.
 - b. C₂H₆ has a higher boiling point than CH₄.
 - c. NaCl is more soluble in water than in benzene(C₆H₆).
 - d. water has such a high surface tension and forms droplets.
 - e. ice is less dense than liquid water.
 - f. water will form a meniscus on glass but will not wet Teflon.
6. Vapor pressure of a liquid in a closed container depends on which of the following? How about the rate of evaporation? Explain your answers.
 - a. what the liquid is
 - b. the volume above the liquid
 - c. the temperature
 - d. the amount of liquid present
 - e. the strength of the intermolecular forces
 - f. the density of the liquid
 - g. the surface area of the liquid
7. Give two reasons why the vapor pressure of a given liquid increases as the temperature is increased.
8. Given air under two conditions, at 35 °C and 15 °C. If the relative humidity is 50% in each case, in which is the vapor pressure the highest? Explain.
9. Explain why cooking food in boiling water takes a lot longer on top of Pikes Peak and how a pressure cooker makes a difference.