Chemistry 116 - Fall 2021
Dr. Audrey Dell Hammerich
8 - Week of October 10
Intermolecular Forces, Vapor Pressure, Phase Diagrams

NOTE: Quiz on Friday will emphasize gases and material in Monday's lecture. There is no need to memorize the collision formulas!

NOTE: You are very strongly encouraged to read the Chapter from Petrucci on our website. It has a more comprehensive discussion of intermolecular forces than our Zumdahl text.

NOTE: You are not responsible for the Clausius-Clapeyron equation in Chapter 16.10 and you may skip reading from the third paragraph of p. 689 "The qualitative ..." through to the end of this subsection on p. 691.

LAB ASSIGNMENT: *Online* H_KH 4-4: Determination of Glucose in Blood Serum (Spectrophotometry, Calibration Curve) (H 4-7–4-8,18-1–18-3)

LECTURE ASSIGNMENT: Online OWL assigned homework due on Monday, October 18 at noon except "W" problems are due Friday, October 15 at noon.

Monday, October 11

Reading Assignment: Z 5.10 [finish van der Waals gases] Z Ch 16.1, Petrucci 12.1 [know the different nonbonding interactions and their relative strength; discuss these forces in terms of charges; be able to predict the major **intermolecular forces** in a compound and state how these forces would effect various physical phenomena such as melting point, boiling point; know **the van der Waals forces**, **London forces**, and **dispersion forces**; how does a **hydrogen bond** fit into the scheme of forces]

Wednesday, October 13

Reading Assignment: Z Ch 16.1-16.2,16.10 Petrucci 12.1-12.2 [finish intermolecuclar forces fBgen bonding; be able to identify the more important **intermolecular forces** in a compound; understand how vapor presssure, boiling point, and melting point are related to intermolecular forces and be able to predict trends; understand the relationship between vapor pressure and a change of state or a phase transition]

Friday, October 15

Reading Assignment: Z Chapter 16.11, Petrucci 12.4 [phase equilibrium, phase transition, be able to interpret a simple **phase diagram**; **triple, point, critical point**; know where the vaporization (vapor pressure) curve is and where the fusion (melting curve) is]

CHEMISTRY 116 - Fall 2020

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Discussion Worksheet - Week 8

1. For the following molecules list the kinds of intermolecular forces expected and briefly explain.

   a) BF_3

   b) $CH_3CH_2CH_2CH_2CH_3$

   c) H_2S

2. Which of the following compounds has the smallest London forces and which has the largest? Why ?

   C_2H_5OH CH_3OH C_3H_7OH

3. Put a check for the dominant intermolecular attractive force.

molecule	dipole-dipole	ion-dipole	dispersion	H bonding
Ar(*g*)				
KI(*aq*)				
Br_2(*l*)				
H_2O(*s*)				
ClF(*g*)				

4. Circle the molecule that has the property.

property	molecule	
higher vapor pressure	HCl	HI
higher boiling point	NaCl	NaI
higher boiling point	NH_3	PH_3
lower vapor pressure	Cl_2	I_2
lower boiling point	H_2O	H_2S

5. The normal boiling points of the fluorides of the second period elements are: LiF, 1676^{o}C; BeF_2, 1175^{o}C; BF_3, -100^{o}C; CF_4, -128^{o}C; NF_3, -129^{o}C; OF_2, -145^{o}C; F_2, -188^{o}C. Describe the nature of the intermolecular forces in this series of liquids and account for the trends in boiling point.

6. Iridium melts at a temperature of 2410^{o}C and boils at 4130^{o}C, whereas sodium melts at a temperature of 97.8^{o}C and boils at 904^{o}C. Predict which of the two molten metals has the larger surface tension at its melting point. Explain your prediction.

7. Under room temperature conditions, fluorine and chlorine are gases, bromine is a liquid, and iodine is a solid. Explain the origin of this trend in the physical state of the halogens.

8. Draw a phase diagram for a simple pure substance that exhibits three different phases: solid, liquid, gas and whose solid has a greater density than the liquid. Identify what each line and each unique point in your sketch corresponds to.

9. Refer to the phase diagram for argon in the lecture notes and determine whether argon is a solid, a liquid, or a gas at each of the following combinations of temperature and pressure:

a) 50 atm and 100 K

b) 8 atm and 150 K

c) 1.5 atm and 25 K

d) 0.25 atm and 120 K

10. At its melting point of 624°C, the density of solid plutonium is 16.24 g cm^{-3}. The density of liquid plutonium is 16.66 g cm^{-3}. A small sample of liquid plutonium at 625°C is strongly compressed. What will be observed?

11. Will carbon dioxide gas melt boil condense to a solid condense to a liquid none of these when compressed at 25°C. The triple point is -57°C and 5.1 atm and the critical point is 31°C and 73 atm. Why?

12. The vapor pressure of solid acetylene at -84.0°C is 760 torr.

a) Does the triple point temperature lie above or below -84.0°C? Why?

b) A sample of solid acetylene is held under an external pressure of 0.80 atm and heated from 10 K to 300 K. What will be observed?

13. When cooled at a pressure of 126 atm iodine vapor will evaporate sublime condense (crystallize) none of these. The triple point is 114°C and 90.1 mm Hg and the critical point is 512°C and 116 atm. Why?

14. The normal melting point of bismuth is 271.3°C.

a) At its normal melting point, the density of solid bismuth is 9.73 g cm^{-3} and that of liquid bismuth is 10.05 g cm^{-3}. Does the volume of a sample of bismuth increase or decrease on melting?

b) A sample of solid bismuth is held at a temperature of 271.0°C and compressed. What will be observed?

c) The vapor pressure of liquid bismuth has been measured to be 5.0 atm at a temperature of 1850°C. Does its normal boiling point lie above or below this temperature?

d) At 1060°C the vapor pressure of liquid bismuth is 0.013 atm. Calculate the number of bismuth atoms per cubic centimeter at equilibrium in the vapor above liquid bismuth at this temperature.

e) Bismuth forms BiF_3 and BiF_5. As is usually the case, the compound with the metal in the lower oxidation state has more ionic character, whereas that with the metal in the higher oxidation state has more covalent (molecular) character. Predict which bismuth fluoride will have the higher boiling point.

f) Will AsF_5 have a higher or a lower normal boiling point than BiF_5?