

Name:
College ID:
Thomas Edison State University
General Chemistry II with Labs (CHE-122)
Section no.:
Semester and year:

Written Assignment 1: Intermolecular Forces and Liquids and Solids

Answer all assigned questions and problems, and show all work.

1. Explain and give an example for each type of intermolecular force. (12 points)

- dipole-dipole interaction
- dipole-induced dipole interaction
- ion-dipole interaction
- dispersion forces (London forces)
- van der Waals forces
- hydrogen bond

(Reference: Chang 11.1)

2. The binary hydrogen compounds of the Group 4A elements and their boiling points are: CH_4 , -162°C ; SiH_4 , -112°C ; GeH_4 , -88°C ; and SnH_4 , -52°C . Explain the increase in boiling points from CH_4 to SnH_4 . (4 points)

(Reference: Chang 11.9)

3. Arrange the following in order of increasing boiling point: RbF , CO_2 , CH_3OH , CH_3Br . Explain your reasoning. (4 points)

(Reference: Chang 11.13)

4. Which member of each of the following pairs of substances would you expect to have a higher boiling point? (6 points)

- O_2 and Cl_2

- b. SO_2 and CO_2
- c. HF and HI

(Reference: Chang 11.15)

5. Explain in terms of intermolecular forces why (a) NH_3 has a higher boiling point than CH_4 and (b) KCl has a higher melting point than I_2 . (4 points)

(Reference: Chang 11.17)

6. What kind of attractive forces must be overcome in order to (a) melt ice, (b) boil molecular bromine, (c) melt solid iodine, and (d) dissociate F_2 into F atoms? (4 points)

(Reference: Chang 11.18)

7. A glass can be filled slightly above the rim with water. Explain why the water does not overflow. (3 points)

(Reference: Chang 11.25)

8. Outdoor water pipes have to be drained or insulated in winter in a cold climate. Why? (3 points)

(Reference: Chang 11.30)

9. Explain and give an example for each type of crystal: (8 points)
- a. ionic crystal
 - b. covalent crystal
 - c. molecular crystal
 - d. metallic crystal

10. Classify the solid state of the following substances as ionic crystals, covalent crystals, molecular crystals, or metallic crystals. (a) CO_2 , (b) B_{12} , (c) S_8 , (d) KBr , (e) Mg , (f) SiO_2 , (g) LiCl , (h) Cr . (8 points)

(Reference: Chang 11.55)

11. What is an amorphous solid? How does it differ from a crystalline solid? (3 points)

(Reference: Chang 11.57)

12. What is a phase change? Construct a heating-cooling curve for a substance that freezes at -23.0°C and has a boiling point of 67.0°C . Name all possible changes that can occur among the vapor, liquid, and solid phases of this substance, and name the four phase change enthalpies involved. Indicate whether these changes are exothermic or endothermic. (6 points)

13. Why is solid carbon dioxide called dry ice? (3 points)

(Reference: Chang 11.71)

14. Which of the following phase transitions gives off more heat? (a) 1 mole of steam to 1 mole of water at 100°C , or 1 mole of water to 1 mole of ice at 0.0°C . (3 points)

(Reference: Chang 11.73)

15. Calculate the amount of heat (in kJ) required to convert 74.6 g of water to steam at 100°C . (Specific heat of water = $4.184\text{ J/g} \cdot ^\circ\text{C}$; $\Delta H_{\text{fus}}(\text{H}_2\text{O}) = 6.01\text{ kJ/mol}$; $\Delta H_{\text{vap}}(\text{H}_2\text{O}) = 40.79\text{ kJ/mol}$). (5 points)

(Reference: Chang 11.75)

16. How is the rate of evaporation of a liquid affected by (a) temperature, (b) the surface area of a liquid exposed to air, (c) intermolecular forces? (3 points)

(Reference: Chang 11.77)

17. The following compounds, listed with their boiling points, are liquid at -10°C : butane, -0.5°C ; ethanol, 78.3°C ; toluene, 110.6°C . At -10°C , which of these liquids would you expect to have the highest vapor pressure? Which the lowest? Explain. (4 points)

(Reference: Chang 11.79)

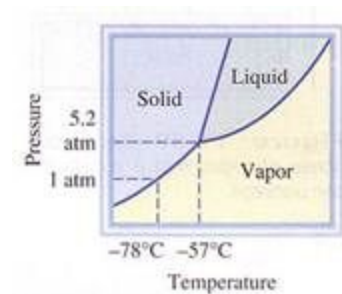
18. A student hangs wet clothes outdoors on a winter day when the temperature is -15°C . After a few hours, the clothes are found to be fairly dry. Describe the phase changes in this drying process. (2 points)

(Reference: Chang 11.81)

19. Determine the final state and its temperature when 150.0 kJ of heat are added to 50.0 g of water at 20°C . (Specific heat of water = $4.184\text{ J/g }^{\circ}\text{C}$; Specific heat of steam = $1.99\text{ J/g }^{\circ}\text{C}$; $\Delta H_{\text{fus}}(\text{H}_2\text{O}) = 6.01\text{ kJ/mol}$; $\Delta H_{\text{vap}}(\text{H}_2\text{O}) = 40.79\text{ kJ/mol}$). (5 points)

(Reference: Chang 11.118)

20. Referring to the phase diagram of CO_2 below, determine the stable phase of CO_2 at (a) 4 atm and -60°C ; and (b) 0.5 atm and -20°C (2 points)



21. If water were a linear molecule, (a) would it still be polar, and (b) would the water molecules still be able to form hydrogen bonds with one another? (4 points)

(Reference: Chang 11.121)

22. A pressure cooker is a sealed container that allows steam to escape when it exceeds a predetermined pressure. How does this device reduce the time needed for cooking? (4 points)

(Reference: Chang 11.131)