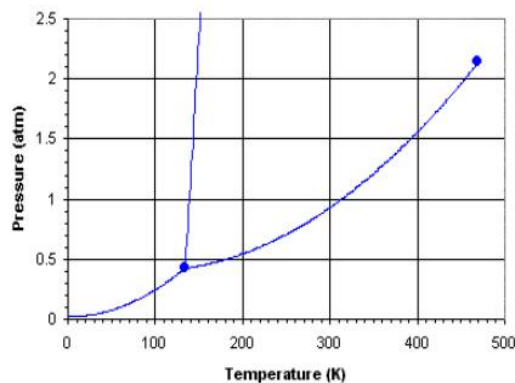


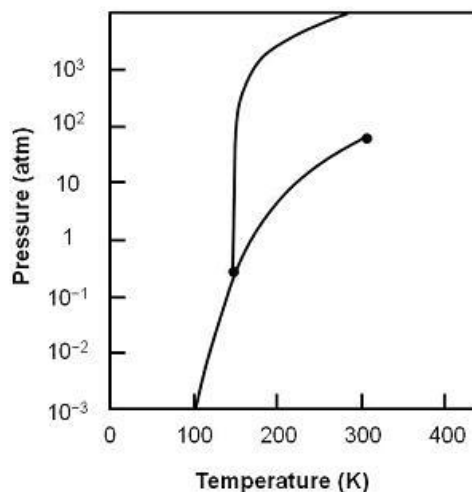
Chapter 11 Homework

Part A multiple choice (select the one that is best in each case. 1point/question)

- E 1. _____ are particularly polarizable.
- A) Small nonpolar molecules
 - B) Small polar molecules
 - C) Large nonpolar molecules
 - D) Large polar molecules
 - E) Large molecules, regardless of their polarity
- B 2. Refer to the phase diagram shown below for an unidentified organic compound X. In what state of matter does this organic compound exist at 273 K and 1 atm?



- A) solid
 - B) liquid
 - C) mixture of liquid and gas
 - D) mixture of solid and liquid
 - E) gas
- B 3. Which of substance is hydrogen bonding likely to play an important role in determining physical properties
- A) methane (CH_4)
 - B) hydrazine (H_2NNH_2)
 - C) methyl fluoride (CH_3F)
 - D) hydrogen sulfide (H_2S)
- B 4. The (unlabeled) phase diagram for an unknown substance is shown below. What is the approximate normal boiling point for this substance?



Chapter 11 Homework

- A) 300 K
- B) 170 K
- C) 150 K
- D) This substance has a normal sublimation point rather than a normal boiling point.

- E
5. On a phase diagram, the critical pressure is _____.
- A) the pressure required to melt a solid
 - B) the pressure below which a substance is a solid at all temperatures
 - C) the pressure above which a substance is a liquid at all temperatures
 - D) the pressure at which a liquid changes to a gas
 - E) the pressure required to liquefy a gas at its critical temperature

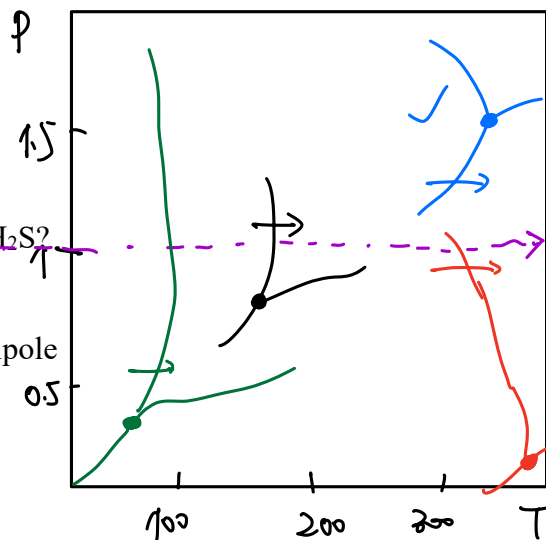
- C
6. The table below gives the temperature and pressure of the triple point for four different substances.

| Substance | Temperature (K) | Pressure (atm) |
|-------------------|-----------------|----------------|
| → Xe | 161 | 0.80 |
| → UF ₆ | 337 | 1.50 |
| → I ₂ | 387 | 0.12 |
| → CO | 68 | 0.15 |

On heating from low temperature at 1 atm pressure which substance is most likely to sublime rather than melt?

- A) CO
- B) I₂
- C) UF₆
- D) Xe

- D
7. What types of intermolecular forces exist between HCl and H₂S?
- A) dipole-dipole and ion-dipole
 - B) dispersion forces, dipole-dipole, and ion-dipole
 - C) dispersion forces, hydrogen bonding, dipole-dipole, and ion-dipole
 - D) dispersion forces and dipole-dipole
 - E) dispersion forces and ion-dipole



- D
8. Which one of the following is *not* characteristic of a liquid?
- A) is almost incompressible
 - B) has a density quite close to that of the solid state
 - C) flows readily
 - D) diffusion within it occurs rapidly
 - E) has a distinguishable or visible surface

- D
9. Predict the order of decreasing boiling points for the following: Ar, Cl₂, CH₄, and CH₃COOH
- A) CH₄, Ar, CH₃COOH, Cl₂
 - B) Cl₂, CH₃COOH, Ar, CH₄
 - C) CH₄, Ar, Cl₂, CH₃COOH
 - D) CH₃COOH, Cl₂, Ar, CH₄
 - E) Ar, Cl₂, CH₄, CH₃COOH

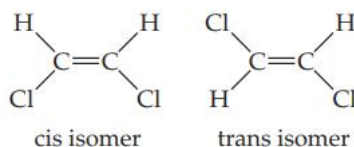
Chapter 11 Homework

- C 10. Which is the best statement comparing the nematic liquid-crystalline phase and the ordinary liquid phase?
- A) There is no special alignment in an ordinary liquid, while nematic phases are aligned along several directions.
 - B) There is no special alignment in an ordinary liquid, while nematic phases are aligned along their short axis.
 - C) There is no special alignment in an ordinary liquid, while nematic phases are aligned along their long axis.
 - D) They both pass through an intermediate phase upon heating.
- A 11. Liquids that evaporate readily are _____.
A) volatility 挥发性
B) surface tension
C) meniscus
D) capillary action 毛细现象
E) viscosity
- A 12. When a solid is placed in a container and heat is applied, a phase change occurs. which of the following statements are correct.
- A) Temperature remains constant while all of a solid is converted to a liquid.
 - B) When a solid is converted to a liquid, heat is released.
 - C) When heat is applied to a solid, the molecular motion decreases as the temperature increases.
 - D) The average kinetic energy of the system changes while all of a solid is converted to a liquid.
 - E) The temperature increases while all of a liquid is converted to a gas.
- B 13. Which statements about viscosity are true?
- (i) Viscosity increases as temperature increases.
 - (ii) Viscosity increases as molecular weight increases.
 - (iii) Viscosity increases as intermolecular forces increase.
- A) (i) only B) (ii) and (iii) C) (i) and (iii) D) none E) all
- A 14. When the pressure over a liquid is *decreased*, the boiling point of the liquid will _____.
A) decrease B) remain the same C) increase D) increase or decrease
- E 15. How high a liquid will rise up a narrow tube as a result of capillary action depends on _____.
A) only the magnitude of adhesive forces between the liquid and the tube
B) only the magnitude of cohesive forces in the liquid
C) the viscosity of the liquid
D) gravity alone
E) the magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and the tube, and gravity

Part B short question (15 points)

16. (2 points) Two isomers of the planar compound 1,2-dichloroethylene are shown here

Chapter 11 Homework



(a) Which of the two isomers will have the stronger dipole–dipole forces? (b) One isomer has a boiling point of 60.3 °C and the other 47.5 °C. Which isomer has which boiling point?

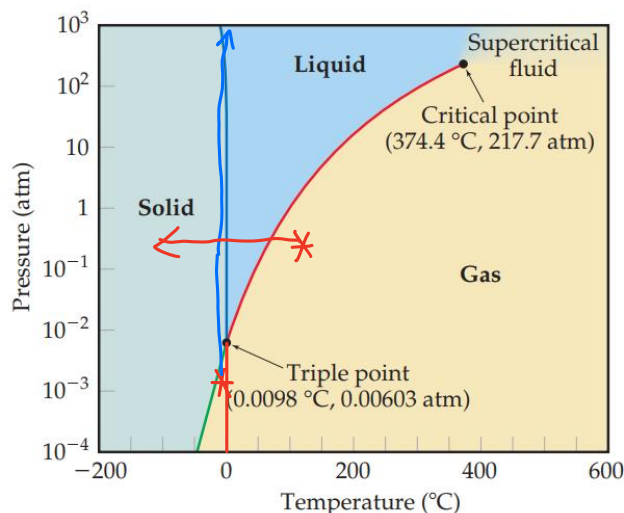
17. (5 points) Ethanol ($\text{C}_2\text{H}_5\text{OH}$) melts at $-114\text{ }^\circ\text{C}$ and boils at $78\text{ }^\circ\text{C}$. The enthalpy of fusion of ethanol is 5.02 kJ/mol, and its enthalpy of vaporization is 38.56 kJ/mol. The specific heats of solid and liquid ethanol are 0.970 and 2.30 J/g·K, respectively. How much heat is required to convert 42.0 g of ethanol at $-155\text{ }^\circ\text{C}$ to the vapor phase at $78\text{ }^\circ\text{C}$?

18. (4 points) The critical temperatures (K) and pressures (atm) of a series of halogenated methanes are as follows:

| Compound | CCl_3F | CCl_2F_2 | CClF_3 | CF_4 |
|----------------------|------------------------|--------------------------|-----------------|---------------|
| Critical temperature | 471 | 385 | 302 | 227 |
| Critical pressure | 43.5 | 40.6 | 38.2 | 37.0 |

Predict the order of increasing intermolecular attraction, from least to most, for this series of compounds.

19. (4 points) describe all the phase changes that would occur in each of the following cases:
 (a) Water vapor originally at 0.005 atm and $0.0\text{ }^\circ\text{C}$ is slowly compressed at constant temperature until the final pressure is 20 atm.
 (b) Water originally at $100.0\text{ }^\circ\text{C}$ and 0.50 atm is cooled at constant pressure until the temperature is $-10\text{ }^\circ\text{C}$.



Chapter 11 Homework Answer Sheet

Name: 陈恺 Student ID: 12311410 Instructor: _____ Score: _____

Part A multiple choice (15 points)

1-5 EBBBE

6-10 CDDDC

11-15 AABAE

Part B short question (15 points)

16 (2 points)

Isomers of 1,2-dichloroethylene

(a) Cis isomer. The cis isomer has both polar C-Cl bonds on the same side, creating a net dipole moment (polar). The trans isomer's dipoles cancel out (nonpolar).

(b) Cis = 60.3°C; Trans = 47.5°C. Stronger intermolecular forces lead to higher boiling points. Since the cis isomer is more polar, it has the higher boiling point.

17 (5 points)

1. Heat Solid (-155°C to -114°C): $q = m \cdot c_{solid} \cdot \Delta T = 42.0\text{g} \times 0.970\text{J/gK} \times 41\text{K} = 1,670\text{ J}$

2. Melt Solid: $n = 42.0\text{g}/46.07\text{g/mol} = 0.912\text{ mol}$

$q = n \cdot \Delta H_{fus} = 0.912\text{mol} \times 5,020\text{J/mol} = 4,578\text{ J}$

3. Heat Liquid (-114°C to 78°C): $q = m \cdot c_{liq} \cdot \Delta T = 42.0\text{g} \times 2.30\text{J/gK} \times 192\text{K} = 18,547\text{ J}$

4. Vaporize Liquid: $q = n \cdot \Delta H_{vap} = 0.912\text{mol} \times 38,560\text{J/mol} = 35,167\text{ J}$

Total: $1,670 + 4,578 + 18,547 + 35,167 = 59,962\text{ J} \approx 60.0\text{ kJ}$

18 (4 points)

$CF_4 < CClF_3 < CCl_2F_2 < CCl_3F$

19 (4 points)

(a) Gas ---> Solid ---> Liquid

Starting at 0.005 atm (below the triple point P of 0.006 atm) and 0°C, water is a Gas. As pressure increases, it crosses the deposition curve to become Solid (Ice). As pressure rises past 1 atm at 0°C, the melting point of ice drops below 0°C, causing the ice to melt into Liquid.

(b) Gas ---> Liquid ---> Solid

At 100°C and 0.50 atm, water is a Gas (since $P < 1\text{ atm}$, boiling point is $< 100^\circ\text{C}$). As it cools, it condenses into a Liquid. Further cooling to -10°C crosses the freezing point, turning it into a Solid.