AP Chapter 11 Study Questions

True/False

Indicate whether the statement is true or false.

1. The principal source of the difference in the normal boiling points of ICl (97°C; molecular mass 162 amu) and Br₂ (59°C; molecular mass 160 amu) is both dipole-dipole interactions and London dispersion forces.

2. The boiling points of normal hydrocarbons are higher than those of branched hydrocarbons of similar molecular weight because the London-dispersion forces between normal hydrocarbons are greater than those between branched hydrocarbons.

3. Heats of vaporization are greater than heats of fusion.

4. Under ordinary conditions, a substance will sublime rather than melt if its triple point occurs at a pressure above atmospheric pressure.

5. The type of solid that is characterized by low melting point, softness, and low electrical conduction is a covalent-network solid.

Multiple Choice

Identify the choice that best completes the statement or answers the question.

6. Based on molecular mass and dipole moment of the five compounds in the table below, which should have the highest boiling point?

<table>
<thead>
<tr>
<th>Substance</th>
<th>Molecular Mass (amu)</th>
<th>Dipole Moment (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane, CH₃CH₂CH₃</td>
<td>44</td>
<td>0.1</td>
</tr>
<tr>
<td>Dimethylether, CH₃OCH₃</td>
<td>46</td>
<td>1.3</td>
</tr>
<tr>
<td>Methylchloride, CH₃Cl</td>
<td>50</td>
<td>1.9</td>
</tr>
<tr>
<td>Acetaldehyde, CH₃CHO</td>
<td>44</td>
<td>2.7</td>
</tr>
<tr>
<td>Acetonitrile, CH₃CN</td>
<td>41</td>
<td>3.9</td>
</tr>
</tbody>
</table>

   a. CH₃CH₂CH₃   b. CH₃OCH₃   c. CH₃Cl   d. CH₃CHO   e. CH₃CN

7. Of the following substances, only __________ has London dispersion forces as its only intermolecular force.
   a. CH₃OH   b. NH₃   c. H₂S   d. CH₄   e. HCl

8. Of the following substances, only __________ has London dispersion forces as the only intermolecular force.
   a. CH₃OH   b. NH₃   c. H₂S   d. Kr   e. HCl

   a. CH₃OH   b. NH₃   c. H₂S   d. Kr   e. HCl

9. Which one of the following should have the lowest boiling point?
   a. PH₃   b. H₂S   c. HCl   d. SiH₄   e. H₂O

10. Of the following substances, __________ has the highest boiling point.
    a. H₂O   b. CO₂   c. CH₄   d. Kr   e. NH₃
11. Of the following, ________ has the highest boiling point.

12. In which of the following molecules is hydrogen bonding likely to be the most significant component of the total intermolecular forces?
   a. CH₄  b. C₅H₁₁OH  c. C₆H₁₃NH₂  d. CH₃OH  e. CO₂

13. Which of the following has dispersion forces as its only intermolecular force?
   a. CH₄  b. HCl  c. C₆H₁₃NH₂  d. NaCl  e. CH₃Cl

14. The substance with the largest heat of vaporization is ________.
   a. I₂  b. Br₂  c. Cl₂  d. F₂  e. O₂

15. Of the following, ________ is an exothermic process.
   a. melting  b. subliming  c. freezing  d. boiling  e. All of the above are exothermic.

16. The heat of fusion of water is 6.01 kJ/mol. The heat capacity of liquid water is 75.3 J/mol • K. The conversion of 50.0 g of ice at 0.00°C to liquid water at 22.0°C requires ________ kJ of heat.
   a. 3.8 × 10²  b. 21.3  c. 17.2  d. 0.469  e. Insufficient data are given.

17. The heating curve shown was generated by measuring the heat flow and temperature for a solid as it was heated. The slope of the ________ segment corresponds to the heat capacity of the liquid of the substance.
   a. AB  b. BC  c. CD  d. DE  e. EF

18. The heating curve shown was generated by measuring the heat flow and temperature for a solid as it was heated. The slope of the ________ segment corresponds to the heat capacity of the gas.
   a. AB  b. BC  c. CD  d. DE  e. EF

19. The heating curve shown was generated by measuring the heat flow and temperature of a solid as it was heated. The heat flow into the sample in the segment ________ will yield the value of the ΔHᵥₐᵖ of this substance.
   a. AB  b. BC  c. CD  d. DE  e. EF

20. The heating curve shown was generated by measuring the heat flow and temperature for a solid as it was heated. The slope of the ________ segment corresponds to the heat capacity of the solid.
   a. AB  b. BC  c. CD  d. DE  e. EF
21. The heating curve shown was generated by measuring the heat flow and temperature of a solid as it was heated. The heat flow into the sample in the segment ________ will yield the value of the $\Delta H_{\text{fusion}}$ of this substance.
   a. AB  b. BC  c. CD  d. DE  e. EF

22. Of the following, ________ should have the highest critical temperature.
   a. CBr$_4$  b. CCl$_4$  c. CF$_4$  d. CH$_4$  e. H$_2$

23. Of the following, ________ is the most volatile.
   a. CBr$_4$  b. CCl$_4$  c. CF$_4$  d. CH$_4$  e. C$_6$H$_{14}$

24. On the phase diagram shown above, segment ________ corresponds to the conditions of temperature and pressure under which the solid and the gas of the substance are in equilibrium.
   a. AB  b. AC  c. AD  d. CD  e. BC

25. On the phase diagram shown above, the coordinates of point ________ correspond to the critical temperature and pressure.

26. The phase diagram of a substance is given above. The region that corresponds to the solid phase is ________.
   a. w  b. x  c. y  d. z  e. x and y
27. The normal boiling point of the substance with the phase diagram shown above is ________°C.
   a. 10   b. 20   c. 30   d. 40   e. 50

28. The phase diagram of a substance is shown above.
   The area labeled ________ indicates the gas phase for the substance.
   a. w   b. x   c. y   d. z   e. y and z

29. According to the phase diagram shown above, the normal boiling point of this substance is
   ________°C.
   a. -3   b. 10   c. 29   d. 38   e. 0

30. Which one of the following cannot form a solid with a lattice based on the sodium chloride structure?
   a. NaBr   b. LiF   c. RbI   d. CuO   e. CuCl₂

31. Gallium crystallizes in a primitive cubic unit cell. The length of the unit cell edge is 3.70 Å. The radius of a Ga atom is ________ Å.
   a. 7.40   b. 3.70   c. 1.85   d. 0.930   e. Insufficient data is given.

32. Potassium metal crystallizes in a body-centered cubic structure with a unit cell edge length of 5.31 Å. The radius of a potassium atom is ________ Å.
   a. 1.33   b. 1.88   c. 2.30   d. 2.66   e. 5.31
33. Which of the following is not a type of solid?
   a. ionic b. molecular c. supercritical
d. metallic e. covalent-network

34. ________ solids consist of atoms or molecules held together by dipole-dipole forces, London dispersion forces, and/or hydrogen bonds.
   a. Ionic b. Molecular c. Metallic
d. Covalent-network e. Metallic and covalent-network

35. Crystalline solids ________.
   a. have their particles arranged randomly
   b. have highly ordered structures
   c. are usually very soft
   d. exist only at high temperatures
   e. exist only at very low temperatures

36. In liquids, the attractive intermolecular forces are ________.
   a. very weak compared with kinetic energies of the molecules
   b. strong enough to hold molecules relatively close together
   c. strong enough to keep the molecules confined to vibrating about their fixed lattice points
   d. not strong enough to keep molecules from moving past each other
   e. strong enough to hold molecules relatively close together but not strong enough to keep molecules from moving past each other

37. As a solid element melts, the atoms become ________ and they have ________ attraction for one another.
   a. more separated, more
   b. more separated, less
   c. closer together, more
   d. closer together, less
   e. larger, greater

38. A gas is ________ and assumes ________ of its container whereas a liquid is ________ and assumes ________ of its container.
a. compressible, the volume and shape, not compressible, the shape of a portion
b. compressible, the shape, not compressible, the volume and shape
c. compressible, the volume and shape, compressible, the volume
d. condensed, the volume and shape, condensed, the volume and shape
   e. condensed, the shape, compressible, the volume and shape

a. the compressible b. the fluid c. the condensed
d. all of the e. the disordered

40. Which statement is true about liquids but not true about solids?
   a. They flow and are highly ordered.
   b. They are highly ordered and not compressible.
   c. They flow and are compressible.
   d. They assume both the volume and the shape of their containers.
   e. They flow and are not compressible.

41. The strongest interparticle attractions exist between particles of a ________ and the weakest interparticle attractions exist between particles of a ________.
   a. solid, liquid b. solid, gas c. liquid, gas
d. liquid, solid e. gas, solid

42. Which one of the following exhibits dipole-dipole attraction between molecules?
   a. XeF₄ b. AsH₃ c. CO₂ d. BCl₃ e. Cl₂

43. When NaCl dissolves in water, aqueous Na⁺ and Cl⁻ ions result. The force of attraction that exists between Na⁺ and H₂O is called a(n) ________ interaction.
   a. dipole-dipole b. ion-ion c. hydrogen bonding
d. ion-dipole e. London dispersion force
44. ________ 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.

45. The ease with which the charge distribution in a 
molecule can be distorted by an external electrical 
field is called the __________.
   a. electronegativity  b. hydrogen bonding  
   c. polarizability  d. volatility  e. viscosity

46. Which one of the following derivatives of ethane 
has the highest boiling point?

47. What is the predominant intermolecular force in 
CBr₅?
   a. London-dispersion forces  b. ion-dipole 
   attraction  c. ionic bonding  d. dipole-dipole 
   attraction  e. hydrogen-bonding

48. The intermolecular force(s) responsible for the fact 
that CH₄ has the lowest boiling point in the set 
CH₄, SiH₄, GeH₄, SnH₄ is/are __________.
   a. hydrogen bonding  b. dipole-dipole 
   interactions  c. London dispersion forces  
   d. mainly hydrogen bonding but also dipole-dipole 
   interactions  e. mainly London-dispersion forces 
   but also dipole-dipole interactions

49. Elemental iodine (I₂) is a solid at room 
temperature. What is the major attractive force that 
exists among different I₂ molecules in the solid?
   a. London dispersion forces  b. dipole-dipole 
   rejections  c. ionic-dipole interactions  
   d. covalent-ionic interactions  e. dipole-dipole 
   attractions

50. Hydrogen bonding is a special case of __________.
   a. London-dispersion forces  b. ion-dipole 
   attraction  c. dipole-dipole attractions  d. ion-ion 
   interactions  e. none of the above

51. Which one of the following substances will have 
hydrogen bonding as one of its intermolecular 
forces?
   a.   
   b.   
   c.   
   d.   
   e.   
52. Which one of the following substances will not have hydrogen bonding as one of its intermolecular forces?
   a. [Image]
   b. [Image]
   c. [Image]
   d. [Image]
   e. [Image]

53. What intermolecular force is responsible for the fact that ice is less dense than liquid water?
   a. London dispersion forces
   b. dipole-dipole forces
   c. ion-dipole forces
   d. hydrogen bonding
   e. ionic bonding

54. The predominant intermolecular force in (CH₃)₂NH is ________.
   a. London dispersion forces
   b. ion-dipole forces
   c. ionic bonding
   d. dipole-dipole forces
   e. hydrogen bonding

55. C₁₂H₂₆ molecules are held together by ________.
   a. ion-ion interactions
   b. hydrogen bonding
   c. ion-dipole interactions
   d. dipole-dipole interactions
   e. dispersion forces

56. Which of the following molecules has hydrogen bonding as its only intermolecular force?
   a. HF
   b. H₂O
   c. C₆H₁₃NH₂
   d. C₅H₁₁OH
   e. None, all of the above exhibit dispersion forces.

57. What types of intermolecular forces exist between HI 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, dipole-dipole, and ion-dipole

58. What type(s) of intermolecular forces exist between Br₂ and CCl₄?
   a. dispersion forces
   b. dispersion forces and ion-dipole
   c. dispersion forces and dipole-dipole
   d. dispersion forces, ion-dipole, and dipole-dipole
   e. None. Since both are gases at room temperature, they do not interact with each other.

59. What type(s) of intermolecular forces exist between Cl₂ and CO₃²⁻?
   a. dispersion forces
   b. dispersion forces and ion-dipole
   c. dispersion forces, ion-dipole, and induced dipole
   d. dispersion forces, and ion-induced dipole
   e. dispersion forces, ion-dipole, dipole-dipole, and ion-induced dipole

60. What types of intermolecular forces exist between NH₃ and CBr₄?
   a. dispersion forces and dipole-dipole forces
   b. dispersion forces and dipole-induced dipole forces
   c. dispersion forces and hydrogen bonds
   d. dispersion forces, hydrogen bonds, and induced dipole-induced dipole forces
   e. dispersion forces, hydrogen bonds, and dipole-induced dipole forces
61. ________ is the energy required to expand the surface area of a liquid by a unit amount of area.
   a. Viscosity  b. Surface tension  c. Volatility  
   d. Meniscus  e. Capillary action

62. Which statements about viscosity are true?
   (i) Viscosity increases as temperature decreases.
   (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

63. The shape of a liquid's meniscus is determined by
   a. the viscosity of the liquid  b. the type of material the container is made of  
   c. the relative magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and its container  
   d. the amount of hydrogen bonding in the liquid  e. the volume of the liquid

64. Viscosity is ________.
   a. the "skin" on a liquid surface caused by intermolecular attraction  b. the resistance to flow
   c. the same as density  d. inversely proportional to molar mass  e. unaffected by temperature

65. How high a liquid will rise up a narrow tube as a result of capillary action depends on ________.
   a. the magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and the tube, and gravity b. gravity alone  
   c. only the magnitude of adhesive forces between the liquid and the tube  d. the viscosity of the liquid  
   e. only the magnitude of cohesive forces in the liquid

66. The property responsible for the "beading up" of water is ________.
   a. density  b. viscosity  c. vapor pressure  d. surface tension  e. hydrogen bonding

67. Heat of sublimation can be approximated by adding together ________ and ________.
   a. heat of fusion, heat of condensation  b. heat of fusion, heat of vaporization  
   c. heat of freezing (solidification), heat of condensation  d. heat of freezing (solidification), heat of vaporization  
   e. heat of deposition, heat of vaporization

68. Which of the following statements is false?
   a. The absolute value of the heat of sublimation is equal to the absolute value of the heat of deposition.
   b. The heat of sublimation is equal to the sum of the heat of vaporization and the heat of melting.
   c. The heat of sublimation is equal to the sum of the heat of vaporization and the heat of freezing.
   d. The absolute value of the heat of sublimation is equal to the absolute value of the sum of the heat of condensation and the heat of freezing.
   e. The absolute value of the heat of deposition is equal to sum of the absolute value of the heat of vaporization and the absolute value of the heat of freezing.
The phase changes $B \rightarrow C$ and $D \rightarrow E$ are not associated with temperature increases because the heat energy is used up to ________.

a. increase distances between molecules  
b. break intramolecular bonds  
c. rearrange atoms within molecules  
d. increase the velocity of molecules  
e. increase the density of the sample

70. Based on the following information, which compound has the strongest intermolecular forces?

<table>
<thead>
<tr>
<th>Substance</th>
<th>$\Delta H_{\text{vap}}$ (kJ/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argon (Ar)</td>
<td>6.3</td>
</tr>
<tr>
<td>Benzene (C$_6$H$_6$)</td>
<td>31.0</td>
</tr>
<tr>
<td>Ethanol (C$_2$H$_5$OH)</td>
<td>39.3</td>
</tr>
<tr>
<td>Water (H$_2$O)</td>
<td>40.8</td>
</tr>
<tr>
<td>Methane (CH$_4$)</td>
<td>9.2</td>
</tr>
</tbody>
</table>

a. Argon  
b. Benzene  
c. Ethanol  
d. Water  
e. Methane

71. Which of the following is not an existing or a potential application of the supercritical carbon dioxide?

a. extraction of caffeine from coffee beans  
b. isolation of the flavor components of herbs and spices  
c. extraction of essential flavor elements from hops for use in brewing  
d. use as a solvent in dry cleaning  
e. use as a coolant in refrigeration

72. Calculate the enthalpy change associated with the conversion of 25.0 grams of ice at -4.00°C to water vapor at 110.0°C. The specific heats of ice, water, and steam are 2.09 J/g-K, 4.18 J/g-K, and 1.84 J/g-K, respectively. For H$_2$O, $\Delta H_{\text{fus}} = 6.01$ kJ/mol and $\Delta H_{\text{vap}} = 40.67$ kJ/mol.

a. $64.8$ kJ  
b. $75.9$ kJ  
c. $1.11 \times 10^4$ kJ  
d. $1.12 \times 10^4$ kJ  
e. $1.00 \times 10^5$ kJ
73. Large intermolecular forces in a substance are manifested by __________.
   a. low vapor pressure   b. high boiling point   c. high heats of fusion and vaporization   d. high critical temperatures and pressures   e. all of the above

74. A substance that expands to fill its container yet has a density approaching that of a liquid, and that can behave as a solvent is called a(n) __________.
   a. plasma   b. gas   c. liquid   d. amorphous solid   e. supercritical fluid and gas

75. The critical temperature and pressure of CS$_2$ are 279°C and 78 atm, respectively. At temperatures above 279°C and pressures above 78 atm, CS$_2$ can only occur as a __________.
   a. solid   b. liquid   c. liquid and gas   d. gas   e. supercritical fluid

76. A volatile liquid is one that __________.
   a. is highly flammable   b. is highly viscous   c. is highly hydrogen-bonded   d. is highly cohesive   e. readily evaporates

77. In general, the vapor pressure of a substance increases as __________ increases.
   a. surface tension   b. molecular weight   c. hydrogen bonding   d. viscosity   e. temperature

78. The vapor pressure of any substance at its normal boiling point is
   a. 1 Pa   b. 1 torr   c. 1 atm   d. equal to atmospheric pressure   e. equal to the vapor pressure of water

79. Volatility and vapor pressure are __________.
   a. inversely proportional to one another   b. directly proportional to one another   c. not related   d. the same thing   e. both independent of temperature

80. Some things take longer to cook at high altitudes than at low altitudes because __________.
   a. water boils at a lower temperature at high altitude than at low altitude   b. water boils at a higher temperature at high altitude than at low altitude   c. heat isn't conducted as well in low density air   d. natural gas flames don't burn as hot at high altitudes   e. there is a higher moisture content in the air at high altitude

81. The vapor pressure of a liquid __________.
   a. increases linearly with increasing temperature   b. increases nonlinearly with increasing temperature   c. decreases linearly with increasing temperature   d. decreases nonlinearly with increasing temperature   e. is totally unrelated to its molecular structure

82. The slope of a plot of the natural log of the vapor pressure of a substance versus 1/T is __________.
   a. $\Delta H_{\text{vap}}$   b. $-\Delta H_{\text{vap}}$   c. $\frac{1}{\Delta H_{\text{vap}}}$   d. $\frac{\Delta H_{\text{vap}}}{R}$   e. $\frac{-1}{\Delta H_{\text{vap}}}$

83. Diethyl ether is a volatile organic compound. The vapor pressure of diethyl ether is 401 mm Hg at 18°C and the $\Delta H_{\text{vap}} = 26.0$ kJ/mol. Calculate the vapor pressure of diethyl ether at 25°C.
   a. 401 mm Hg   b. 500 mm Hg   c. 517 mm Hg   d. 598 mm Hg   e. 605 mm Hg

84. Diethyl ether is a volatile organic compound. The vapor pressure of diethyl ether is 401 mm Hg at 18°C and the $\Delta H_{\text{vap}} = 26.0$ kJ/mol. Calculate the vapor pressure of diethyl ether at 0°C.
   a. 150 mm Hg   b. 198 mm Hg   c. 334 mm Hg   d. 598 mm Hg   e. 815 mm Hg

85. Diethyl ether is a volatile organic compound. The vapor pressure of diethyl ether is 401 mm Hg at 18°C and the $\Delta H_{\text{vap}} = 26.0$ kJ/mol. Calculate the vapor pressure of diethyl ether at 40°C.
   a. 401 mm Hg   b. 517 mm Hg   c. 598 mm Hg   d. 605 mm Hg   e. 853 mm Hg
86. The phase diagram of a substance is given above. This substance is a _________ at 25°C and 1.0 atm.
   a. solid  b. liquid  c. gas  d. supercritical fluid  e. crystal

87. 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

88. On a phase diagram, the critical temperature is __________.
   a. the temperature below which a gas cannot be liquefied  b. the temperature above which a gas cannot be liquefied  c. the temperature at which all three states are in equilibrium  d. the temperature required to melt a solid  e. the temperature required to cause sublimation of a solid

89. On a phase diagram, the melting point is the same as __________.
   a. the triple point  b. the critical point  c. the freezing point  d. the boiling point  e. the vapor-pressure curve

90. When the phase diagram for a substance has a solid-liquid phase boundary line that has a negative slope (leans to the left), the substance _________.
   a. can go from solid to liquid, within a small temperature range, via the application of pressure  b. sublimes rather than melts under ordinary conditions  c. cannot go from solid to liquid by application of pressure at any temperature  d. cannot be liquefied above its triple point  e. melts rather than sublimes under ordinary conditions

91. Crystalline solids differ from amorphous solids in that crystalline solids have __________.
   a. appreciable intermolecular attractive forces  b. a long-range repeating pattern of atoms, molecules, or ions  c. atoms, molecules, or ions that are close together  d. much larger atoms, molecules, or ions  e. no orderly structure

92. The unit cell with all sides the same length and all angles equal to 90° that has lattice points only at the corners is called __________.
   a. monoclinic  b. body-centered cubic  c. primitive cubic  d. face-centered cubic  e. spherical cubic
93. What fraction of the volume of each corner atom is actually within the volume of a face-centered cubic unit cell?
   a. 1  b. \(\frac{1}{2}\)  c. \(\frac{1}{4}\)  d. \(\frac{1}{8}\)  e. \(\frac{1}{16}\)

94. CsCl crystallizes in a unit cell that contains the Cs\(^+\) ion at the center of a cube that has a Cl\(^-\) at each corner. Each unit cell contains ________ Cs\(^+\) ions and ________ Cl\(^-\) ions, respectively.
   a. 1 and 8  b. 2 and 1  c. 1 and 1  d. 2 and 2  e. 2 and 4

95. The predominant intermolecular force in CaBr\(_2\) is ________.
   a. London-dispersion forces  b. ion-dipole forces  c. ionic bonding  d. dipole-dipole forces  e. hydrogen bonding

96. CsCl crystallizes in a unit cell that contains a Cs\(^+\) ion at the center of a cube and a Cl\(^-\) ion at each corner. The unit cell of CsCl is ________.
   a. close packed  b. body-centered cubic  c. face-centered cubic  d. amorphous  e. primitive cubic

97. NaCl crystallizes in a face-centered cubic cell. What is the total number of ions (Na\(^+\) ions and Cl\(^-\) ions) that lie within a unit cell of NaCl?
   a. 2  b. 4  c. 8  d. 6  e. 5

98. What portion of the volume of each atom or ion on the face of a unit cell is actually within the unit cell?
   a. 1/2  b. 1/4  c. 3/4  d. all of it  e. none of it

99. The scattering of light waves upon passing through a narrow slit is called ________.
   a. diffusion  b. grating  c. diffraction  d. adhesion  e. incidence

100. Consider the following statements about crystalline solids:
   (i) Molecules or atoms in molecular solids are held together via intermolecular forces.
   (ii) Metallic solids have atoms in the points of the crystal lattice.
   (iii) Ionic solids have formula units in the point of the crystal lattice.
   (iv) Atoms in covalent-network solids are connected via a network of covalent bonds.

Which of the statements is false?
   a. (i)  b. (ii)  c. (iii)  d. (iv)  e. none

101. A solid has a very high melting point, great hardness, and poor electrical conduction. This is a(n) ________ solid.
   a. ionic  b. molecular  c. metallic  d. covalent network  e. metallic and covalent network

102. An ionic solid, NaCl (s), dissolves in water because of the ________.
   a. relatively low lattice energy due to small charges of Na\(^+\) and Cl\(^-\) ions  b. simple face-centered cubic unit cell type it forms  c. 1:1 ratio of ions in the unit cell  d. strong coulombic interactions between oppositely charged ions  e. relatively low melting point

103. Metallic solids do not exhibit ________.
   a. excellent thermal conductivity  b. excellent electrical conductivity  c. variable hardness  d. extreme brittleness  e. variable melting point

104. The enthalpy change for converting 1.00 mol of ice at -50.0°C to water at 70.0°C is ________ kJ. The specific heats of ice, water, and steam are 2.09 J/g·K, 4.18 J/g·K, and 1.84 J/g·K, respectively. For H\(_2\)O, \(\Delta H_{\text{fus}}\) = 6.01 kJ/mol, and \(\Delta H_{\text{vap}}\) = 40.67 kJ/mol
   a. 12.28  b. 6.41  c. 13.16  d. 7154  e. 9.40
105. The enthalpy change for converting 10.0 g of ice at -25.0°C to water at 80.0°C is __________ kJ. The specific heats of ice, water, and steam are 2.09 J/g-K, 4.18 J/g-K, and 1.84 J/g-K, respectively. For H₂O, ΔH₉₀ = 6.01 kJ/mol, and ΔHᵥₐₚ = 40.67 kJ/mol.
   a. 12.28  b. 6.16  c. 3870  d. 7.21  e. 9.88

106. The fluorocarbon C₂Cl₃F₃ has a normal boiling point of 47.6°C. The specific heats of C₂Cl₃F₃ (l) and C₂Cl₃F₃(g) are 0.91 J/g-K and 0.67 J/g-K, respectively. The heat of vaporization of the compound is 27.49 kJ/mol. The heat required to convert 50.0 g of the compound from the liquid at 5.0°C to the gas at 80.0°C is __________ kJ.
   a. 8.19  b. 1454  c. 30.51  d. 3031  e. 10.36

107. Ethanol (C₂H₅OH) melts at -114°C. The enthalpy of fusion is 5.02 kJ/mol. The specific heats of solid and liquid ethanol are 0.97 J/g-K and 2.3 J/g-K, respectively. How much heat (kJ) is needed to convert 25.0 g of solid ethanol at -135°C to liquid ethanol at -50°C?
   a. 207.3  b. -12.7  c. 6.91  d. 4192  e. 9.21

108. Based on the figure above, the boiling point of diethyl ether under an external pressure of 1.32 atm is __________°C.
   a. 10  b. 20  c. 30  d. 40  e. 0

109. Based on the figure above, the boiling point of ethyl alcohol under an external pressure of 0.0724 atm is __________°C.
   a. 80  b. 60  c. 70  d. 40  e. 20
110. Based on the figure above, the boiling point of water under an external pressure of 0.316 atm is ________°C.
   a. 70  b. 40  c. 60  d. 80  e. 90

Completion
Complete each statement.

111. In general, intramolecular forces determine the ________ properties of a substance and intermolecular forces determine its ________ properties.

112. London Dispersion Forces tend to ________ in strength with increasing molecular weight.

113. The direct conversion of a solid to a gas is called ________.

114. How many atoms are contained in a face-centered cubic unit cell?

115. Chromium crystallizes in a body-centered cubic unit cell. There are ________ chromium atoms per unit cell.

116. When lattice points occur only at the corners of a unit cell, the cell is called ________.

117. When lattice points occur at the corners and at the center of a unit cell, the cell is called ________.

118. When lattice points occur at the center of each face, as well as each corner of a unit cell, the cell is called ________.
AP Chapter 11 Study Questions
Answer Section

TRUE/FALSE

1. ANS: F  PTS: 1  DIF: 2  REF: Sec. 11.2
2. ANS: T  PTS: 1  DIF: 2  REF: Sec. 11.2
3. ANS: T  PTS: 1  DIF: 1  REF: Sec. 11.4
4. ANS: T  PTS: 1  DIF: 2  REF: Sec. 11.6
5. ANS: F  PTS: 1  DIF: 2  REF: Sec. 11.6

MULTIPLE CHOICE

6. ANS: E  PTS: 1  DIF: 3  REF: Sec. 11.2
7. ANS: D  PTS: 1  DIF: 2  REF: Sec. 11.2
8. ANS: D  PTS: 1  DIF: 2  REF: Sec. 11.2
9. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.2
10. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.2
11. ANS: B  PTS: 1  DIF: 3  REF: Sec. 11.2
12. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.2
13. ANS: A  PTS: 1  DIF: 2  REF: Sec. 11.2
14. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.4
15. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.4
16. ANS: B  PTS: 1  DIF: 3  REF: Sec. 11.4
17. ANS: C  PTS: 1  DIF: 1  REF: Sec. 11.4
18. ANS: E  PTS: 1  DIF: 1  REF: Sec. 11.4
19. ANS: D  PTS: 1  DIF: 2  REF: Sec. 11.4
20. ANS: A  PTS: 1  DIF: 1  REF: Sec. 11.4
21. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.4
22. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.4
23. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.5
24. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.6
25. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.6
26. ANS: A  PTS: 1  DIF: 2  REF: Sec. 11.6
27. ANS: D  PTS: 1  DIF: 2  REF: Sec. 11.6
28. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.6
29. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.6
30. ANS: E  PTS: 1  DIF: 3  REF: Sec. 11.7
31. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.7
32. ANS: C  PTS: 1  DIF: 5  REF: Sec. 11.7
33. ANS: C  PTS: 1  DIF: 3  REF: Sec. 11.8
34. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.8
35. ANS: B  PTS: 1  DIF: 1  REF: Sec. 11.1
36. ANS: E  PTS: 1  DIF: 2  REF: Sec. 11.1
| 37. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.1 |
| 38. | ANS: A | PTS: 1 | DIF: 1 | REF: Sec. 11.1 |
| 39. | ANS: C | PTS: 1 | DIF: 1 | REF: Sec. 11.1 |
| 40. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.1 |
| 41. | ANS: B | PTS: 1 | DIF: 1 | REF: Sec. 11.1 |
| 42. | ANS: B | PTS: 1 | DIF: 3 | REF: Sec. 11.2 |
| 43. | ANS: D | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 44. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 45. | ANS: C | PTS: 1 | DIF: 1 | REF: Sec. 11.2 |
| 46. | ANS: C | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 47. | ANS: A | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 48. | ANS: C | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 49. | ANS: A | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 50. | ANS: C | PTS: 1 | DIF: 1 | REF: Sec. 11.2 |
| 51. | ANS: D | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 52. | ANS: A | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 53. | ANS: D | PTS: 1 | DIF: 1 | REF: Sec. 11.2 |
| 54. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 55. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 56. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.2 |
| 57. | ANS: D | PTS: 1 | DIF: 3 | REF: Sec. 11.2 |
| 58. | ANS: A | PTS: 1 | DIF: 3 | REF: Sec. 11.2 |
| 59. | ANS: D | PTS: 1 | DIF: 3 | REF: Sec. 11.2 |
| 60. | ANS: B | PTS: 1 | DIF: 3 | REF: Sec. 11.2 |
| 61. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.3 |
| 62. | ANS: E | PTS: 1 | DIF: 3 | REF: Sec. 11.3 |
| 63. | ANS: C | PTS: 1 | DIF: 2 | REF: Sec. 11.3 |
| 64. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.3 |
| 65. | ANS: A | PTS: 1 | DIF: 2 | REF: Sec. 11.3 |
| 66. | ANS: D | PTS: 1 | DIF: 2 | REF: Sec. 11.3 |
| 67. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 68. | ANS: C | PTS: 1 | DIF: 3 | REF: Sec. 11.4 |
| 69. | ANS: A | PTS: 1 | DIF: 3 | REF: Sec. 11.4 |
| 70. | ANS: D | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 71. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 72. | ANS: B | PTS: 1 | DIF: 3 | REF: Sec. 11.4 |
| 73. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 74. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 75. | ANS: E | PTS: 1 | DIF: 2 | REF: Sec. 11.4 |
| 76. | ANS: E | PTS: 1 | DIF: 1 | REF: Sec. 11.5 |
| 77. | ANS: E | PTS: 1 | DIF: 1 | REF: Sec. 11.5 |
| 78. | ANS: C | PTS: 1 | DIF: 1 | REF: Sec. 11.5 |
| 79. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.5 |
| 80. | ANS: A | PTS: 1 | DIF: 2 | REF: Sec. 11.5 |
| 81. | ANS: B | PTS: 1 | DIF: 2 | REF: Sec. 11.5 |
82. ANS: D  PTS: 1  DIF: 4  REF: Sec. 11.5
83. ANS: C  PTS: 1  DIF: 5  REF: Sec. 11.5
84. ANS: B  PTS: 1  DIF: 5  REF: Sec. 11.5
85. ANS: E  PTS: 1  DIF: 5  REF: Sec. 11.5
86. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.6
87. ANS: E  PTS: 1  DIF: 2  REF: Sec. 11.6
88. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.6
89. ANS: C  PTS: 1  DIF: 1  REF: Sec. 11.6
90. ANS: A  PTS: 1  DIF: 2  REF: Sec. 11.6
91. ANS: B  PTS: 1  DIF: 2  REF: Sec. 11.7
92. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.7
93. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.7
94. ANS: C  PTS: 1  DIF: 3  REF: Sec. 11.7
95. ANS: C  PTS: 1  DIF: 2  REF: Sec. 11.7
96. ANS: B  PTS: 1  DIF: 3  REF: Sec. 11.7
97. ANS: C  PTS: 1  DIF: 3  REF: Sec. 11.7
98. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.7
99. ANS: C  PTS: 1  DIF: 1  REF: Sec. 11.8
100. ANS: C  PTS: 1  DIF: 3  REF: Sec. 11.8
101. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.8
102. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.8
103. ANS: D  PTS: 1  DIF: 2  REF: Sec. 11.8
104. ANS: C  PTS: 1  DIF: 3  REF: Sec. 11.4
105. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.4
106. ANS: E  PTS: 1  DIF: 4  REF: Sec. 11.4
107. ANS: C  PTS: 1  DIF: 4  REF: Sec. 11.4
108. ANS: D  PTS: 1  DIF: 3  REF: Sec. 11.5
109. ANS: E  PTS: 1  DIF: 3  REF: Sec. 11.5
110. ANS: A  PTS: 1  DIF: 3  REF: Sec. 11.5

**COMPLETION**

111. ANS: chemical, physical

    PTS: 1  DIF: 2  REF: Sec. 11.1

112. ANS: increase

    PTS: 1  DIF: 1  REF: Sec. 11.2

113. ANS: sublimation

    PTS: 1  DIF: 1  REF: Sec. 11.4

114. ANS: 4

    PTS: 1  DIF: 3  REF: Sec. 11.7
115.  ANS: 2

   PTS: 1  DIF: 2  REF: Sec. 11.7

116.  ANS: primitive cubic

   PTS: 1  DIF: 2  REF: Sec. 11.7

117.  ANS: body-centered cubic

   PTS: 1  DIF: 2  REF: Sec. 11.7

118.  ANS: face-centered cubic

   PTS: 1  DIF: 2  REF: Sec. 11.7