CHEM 1411. Chapter 11. Liquid and Intermolecular Forces, Chapter 12. Solids and Modern Materials (*Homework*). ky60

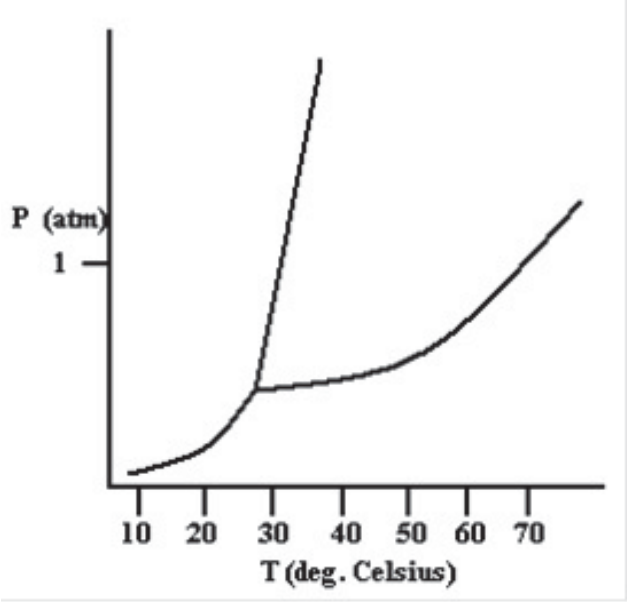
1. Which of the following would be expected to have the *highest* vapor pressure at room temperature?
A. water, bp = 100°C
B. acetone, bp = 56°C
C. ethanol, bp = 78°C
D. methanol, bp = 65°C

2. Of the following, which is the dominant (strongest) type of intermolecular force present in RbCl(s)?
A. Dipole-dipole
B. Hydrogen bonding
C. Ionic
D. Dispersion
E. Ion-dipole

3. The molar enthalpy of vaporization of carbon disulfide is 26.74 kJ/mol, and its normal boiling point is 46°C. What is the vapor pressure of CS_2 at 0°C?
A. 4160 torr
B. 5.47 torr
C. 447 torr
D. 139 torr
E. 313 torr

4.

Based on the phase diagram shown below, how will the melting point of the substance change if the pressure is increased above 1 atm?



A. The substance will not melt at pressures of 1 atm and above; instead, the solid sublimes to form the gas phase.
B. The melting point will decrease.
C. The melting point will increase.
D. The melting point will remain the same.

5.

How much enthalpy is necessary to heat 10.0 g of solid benzene (C_6H_6) at 0.0°C to benzene vapor at 100°C?

Data for Benzene	
melting point	5.5°C
boiling point	80.1°C
specific heat of solid benzene	1.52 J/g·°C
specific heat of liquid benzene	1.73 J/g·°C
specific heat of benzene vapor	1.06 J/g·°C
ΔH_{fus}	9.9 kJ/mol
ΔH_{vap}	30.8 kJ/mol

A. None of the above
B. 4.4 kJ
C. 6.0 kJ
D. 5.2 kJ
E. 6.8 kJ

6. The heat capacity of liquid water is 4.18 J/g·°C and the heat of vaporization is 40.7 kJ/mol. How many kilojoules of heat must be provided to convert 1.00 g of liquid water at 67°C into 1.00 g of steam at 100°C?
A. 40.8 J
B. 22.7 kJ
C. 40.8 kJ
D. 2,400 J
E. 2.2 kJ

7. Identify the dominant (strongest) type of intermolecular force present in $Cl_2(l)$.
A. Dispersion
B. Dipole-dipole
C. Ionic
D. Ion-dipole
E. Hydrogen bonding

8. Which one of the following substances will have both dispersion forces and dipole-dipole forces?
A. H_2
B. BCl_3
C. Br_2
D. CO_2
E. HCl

9. Arrange the following in order of <u>increasing</u> boiling point: RbCl, CH_3Cl, CH_3OH, CH_4.
A. RbCl < CH_3Cl < CH_3OH < CH_4
B. CH_4 < CH_3OH < CH_3Cl < RbCl
C. CH_3OH < CH_4 < CH_3Cl < RbCl
D. CH_4 < CH_3Cl < CH_3OH < RbCl
E. CH_3OH < CH_3Cl < RbCl < CH_4

10. Which type of intermolecular force is the strongest? (*ionic, ion-dipole, dipole-dipole, hydrogen bonding, dispersion*)
A. Ionic
B. Hydrogen bonding
C. Dispersion
D. Dipole-dipole
E. Ion-dipole

11. Which of the following properties is *not* influenced by hydrogen bonding?
A. melting point
B. flammability
C. vapor pressure
D. viscosity
E. boiling point

12. Indicate all the types of intermolecular forces of attraction in $F_2(l)$.
A. Dipole-dipole and Ionic
B. Hydrogen bonding
C. Dispersion and Dipole-dipole
D. Dispersion
E. Ion-dipole

13. Vanadium crystallizes in a body-centered cubic lattice, and the length of the edge of a unit cell is 305 pm. What is the density of V?
A. 5.96×10^{-30} g/cm^3
B. 5.96 g/cm^3
C. 11.9 g/cm^3
D. 2.98×10^{-6} g/cm^3
E. 2.98 g/cm^3

14. The boiling points of propanol ($CH_3CH_2CH_2OH$) and pentanol ($CH_3CH_2CH_2CH_2CH_2OH$) are 97°C and 137°C, respectively. The boiling point of butanol ($CH_3CH_2CH_2CH_2OH$) is predicted to be:
A. > 97°C and < 137°C
B. 137°C
C. > 137°C
D. 97°C
E. < 97°C

15. Magnesium oxide, MgO, melts at 2,800°C and is very hard. The liquid conducts electricity very well. What kind of crystal is this?
A. Ionic Crystal
B. Covalent Crystal
C. Metallic Crystal
D. Molecular Crystal
E. Amorphous (Not a regular crystal)

16. Find the temperature at which ethanol boils on a day in the mountains when the barometric pressure is 547 mmHg. (Given: The heat of vaporization of ethanol is 39.3 kJ/mol; the normal boiling point of ethanol is 78.3°C.)
A. 69.9°C
B. 77.9°C
C. 74.6°C
D. 76.5°C
E. 10.0°C

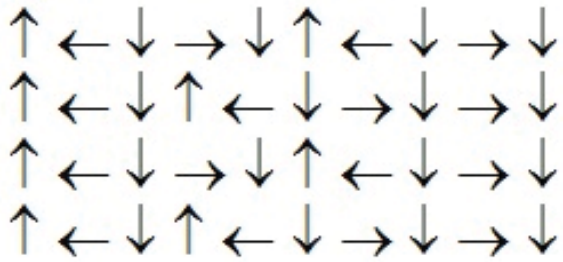
17. Which one of the following substances should exhibit hydrogen bonding in the liquid state?
A. CH_3OH
B. He
C. CH_4
D. PH_3
E. H_2S

18. Which one of the following crystallizes in a metallic lattice?
A. C
B. $K_2Cr_2O_7$
C. $LiClO_4$
D. $NaMnO_4$
E. K

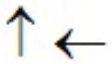
19. The molar heats of sublimation and fusion of iodine are 62.3 kJ/mol and15.3 kJ/mol, respectively. Calculate the molar heat of vaporization of liquid iodine.
A. 4.07 kJ/mol
B. 47.0 kJ/mol
C. –47.0 kJ/mol
D. –77.6 kJ/mol
E. 77.6 kJ/mol

20.

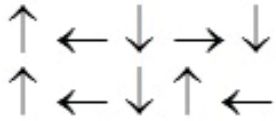
In the following picture, each arrow represents a molecule or atom. Based on the arrangement in the solid state as shown, which of the following best represents the unit cell?



A.

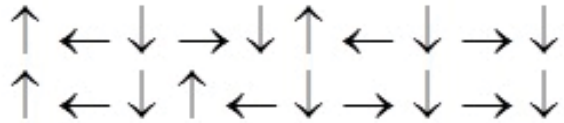


B.



C.

D.



E.

21. MgO has the same crystal structure as NaCl, face-centered cubic. How many oxide ions surround each Mg^{2+} ion as nearest neighbors?
A. 4
B. 6
C. 10
D. 12
E. 8

22. Which of the following is *not* true with regard to water?
A. Water has a high heat capacity.
B. Ice is more dense than liquid water.
C. Water is a polar molecule.
D. Water can form hydrogen bonds.
E. Water has an unusually high boiling point.

23. The number of nearest neighbors (atoms that make contact) around each atom in a face-centered cubic lattice of a metal is
A. 4.
B. 6.
C.

8.

D. 12.
E. 2.

24. Potassium crystallizes in a body-centered cubic lattice. How many atoms are there per unit cell?
A. 8
B. 1
C. 4
D. 6
E. 2

25. Arrange the following substances in order of increasing boiling point: CH_3CH_2OH, $HOCH_2CH_2OH$, CH_3CH_2Cl, and $ClCH_2CH_2OH$
A. $CH_3CH_2Cl < CH_3CH_2OH < ClCH_2CH_2OH < HOCH_2CH_2OH$
B. $CH_3CH_2OH < HOCH_2CH_2OH < CH_3CH_2Cl < ClCH_2CH_2OH$
C. $CH_3CH_2OH < CH_3CH_2Cl < HOCH_2CH_2OH < ClCH_2CH_2OH$
D. $CH_3CH_2OH < ClCH_2CH_2OH < CH_3CH_2Cl < HOCH_2CH_2OH$
E. $CH_3CH_2Cl < ClCH_2CH_2OH < CH_3CH_2OH < HOCH_2CH_2OH$

26. Which of the following liquids would have the highest viscosity at 25°C?
A. CH_3Br
B. CH_3OCH_3
C. $HOCH_2CH_2OH$
D. CH_2Cl_2
E. C_2H_5OH

27. Given that the heat of vaporization of mercury is 59.0 kJ/mol and the vapor pressure of mercury is 0.0017 torr at 25°C, calculate the normal boiling point of mercury.
A. 360°C
B. None of the above
C. 320°C
D. 380°C
E. 340°C

28.

What mass of water would need to evaporate from your skin in order to dissipate 1.7×10^5 J of heat from your body?
$H_2O(l) \rightarrow H_2O(g)$ $\Delta H_{vap} = 40.7$ kJ/mol

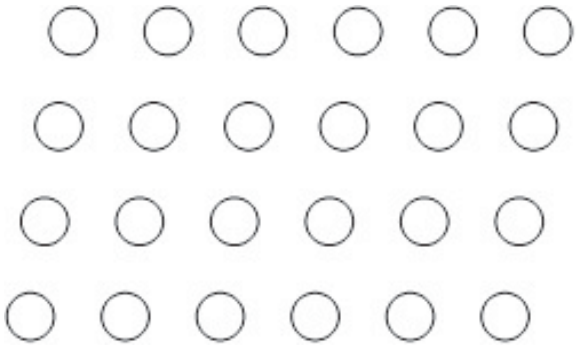
A. 58.4 g
B. 418 g
C. 7.52×10^4 g
D. 6.92×10^6 g
E. 75.2 g

29. Crystals of elemental sulfur are easily crushed, and melt at 113°C. Liquid sulfur does not conduct electricity. What kind of crystal is this?
A. Covalent Crystal
B. Ionic Crystal
C. Amorphous (Not a regular crystal)
D. Molecular Crystal
E. Metallic Crystal

30. Acetic acid has a heat of fusion of 10.8 kJ/mol and a heat of vaporization of 24.3 kJ/mol. What is the expected value for the heat of sublimation of acetic acid?
A. 35.1 kJ/mol
B. –35.1 kJ/mol
C. +13.5 kJ/mol
D. –13.5 kJ/mol
E. Not enough information is given to answer the question.

31.

Suppose the atoms in a two-dimensional crystal have the following arrangement:



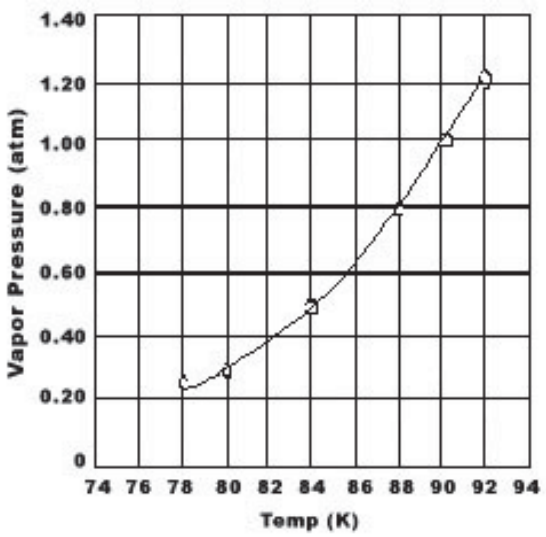
What is the coordination number of each atom in this crystal?

A. Four
B. Six
C. Eight
D. Two
E. None of the above

32. Which of the following phase changes is endothermic?
A. Condensation
B. Deposition
C. Sublimation
D. Freezing

33.

Use the graph of vapor pressure to determine the normal boiling point of O_2.



A. 92 K
B. 90 K
C. O_2 doesn't boil because it is always a gas.
D. 88 K
E. 84 K

34. The molar enthalpy of vaporization of hexane (C_6H_{14}) is 28.9 kJ/mol, and its normal boiling point is 68.73°C. What is the vapor pressure of hexane at 25°C?
A. 3370 torr
B. 171 torr
C. 759 torr
D. 4.44 torr
E. 117 torr

35.

Which of the following constants is/are needed to calculate the amount of energy required to heat 12.0g of $H_2O(l)$ at 30.0°C to $H_2O(l)$ at 85.0°C?
I. ΔH_{fus} (H_2O)
II. ΔH_{vap} (H_2O)
III. specific heat of $H_2O(s)$
IV. specific heat of $H_2O(l)$
V. specific heat of $H_2O(g)$

A. II and IV
B. IV only
C. I and IV
D. I, II, and IV
E. IV and V

36. Each of the following substances is a liquid at –50°C. Place these liquids in order of *increasing* vapor pressure: dimethyl ether (CH_3OCH_3), propane (C_3H_8), and ethanol (CH_3CH_2OH).
A. propane < ethanol < dimethyl ether
B. dimethyl ether < ethanol < propane
C. ethanol < propane < dimethyl ether
D. ethanol < dimethyl ether < propane
E. propane < dimethyl ether < ethanol

37. W(s) is classified as a/an
A. covalent solid.
B. molecular crystal.
C. ionic crystal.
D. metallic crystal.
E. amorphous solid.

38. Which of the following would be expected to have the *lowest* vapor pressure at room temperature?
A. water, bp = 100°C
B. acetone, bp = 56°C
C. methanol, bp = 65°C
D. ethanol, bp = 78°C

39. The intermolecular forces present in CO include which of the following?
I. dipole-dipole
II. ion-dipole
III. dispersion
IV. hydrogen bonding
A. I, III, and IV
B. I and III
C. I and II
D. I, II, III, and IV
E. II and IV

40. Copper crystallizes in a face-centered cubic unit cell. The density of copper is 8.94 g/cm^3. Calculate the length of the edge of the unit cell in pm.
A. None of the above
B. 461 pm
C. 361 pm
D. 261 pm
E. 161 pm

41. Indicate all the types of intermolecular forces of attraction in $SF_4(g)$.
A. Dipole-dipole and Ionic
B. Dispersion
C. Dispersion and Dipole-dipole
D. Hydrogen bonding and Dispersion
E. Ion-dipole and Hydrogen bonding

42.

Which two properties are more typical of molecular compounds than of ionic compounds?
1. They are gases or liquids at room temperature.
2. They have high melting points.
3. Solids do not conduct electricity, but liquids do.
4. Atoms share electrons.

A. 3 and 4
B. 1 and 4
C. 2 and 3
D. 1 and 3
E. 2 and 4

43. The molar enthalpy of vaporization of boron tribromide is 30.5 kJ/mol, and its normal boiling point is 91°C. What is the vapor pressure of BBr_3 at 20°C?
A. 66.1 torr
B. 143 torr
C. 311 torr
D. 11.5 torr
E. 5.31 torr

44. Boron nitride, BN_3, melts at approximately at 3,000°C under high pressure. This material is almost as hard as diamond. What kind of crystal is this?
A. Amorphous (Not a regular crystal)
B. Covalent Crystal
C. Metallic Crystal
D. Molecular Crystal
E. Ionic Crystal

45. Which one of the following substances should exhibit hydrogen bonding in the liquid state?
A. H_2
B. CH_4
C. H_2S
D. SiH_4
E. CH_3NH_2

46.

Which of the following substances is expected to have the highest molar heat of vaporization (ΔH_{vap})?

A. H_2O
B. He
C. NH_3
D. Ar
E. C_6H_6

47. Potassium bromide, KBr, crystallizes like NaCl in a face-centered lattice. The ionic radii of K^+ and Br^- ions are 133 pm and 195 pm, respectively. Assuming that all Br^- ions are positioned in the face and corners of the unit cell, while the K^+ ions are positioned along the edge alternating between anions, calculate the length of a unit cell edge.
A. 780 pm
B. 523 pm
C. 328 pm
D. 656 pm
E. 230 pm

48. The boiling points of chloromethane (CH_3Cl) and dichlormethane (CH_2Cl_2) are – 24 °C and 40.°C respectively. The boiling point of trichloromethane ($CHCl_3$) is predicted to be:
A. > 40.°C
B. 40.°C
C. > – 24 °C and < 40.°C
D. < – 24 °C
E. – 24 °C

49.

Which of the following constants is/are needed to calculate the amount of energy required to heat 30.5g of $H_2O(s)$ at –25.0°C to $H_2O(l)$ at 55.0°C?
I. ΔH_{fus} (H_2O)
II. ΔH_{vap} (H_2O)
III. specific heat of $H_2O(s)$
IV. specific heat of $H_2O(l)$
V. specific heat of $H_2O(g)$

A. I, II, III, IV, and IV
B. I, II, III, and IV
C. III and IV
D. I only
E. I, III, and IV

50. 3.59 g of water was introduced into an evacuated 1.50 L flask at 30°C. What mass of water will evaporate? (Vapor pressure of water at 30°C is 31.82 mmHg.)
A. 0.4187 g
B. 0.04187 g
C. 0.0455g
D. 0.455 g
E. 2.52×10^{-3} g

51. An example of a covalent network solid is
A. potassium.
B. none of these.
C. iodine.
D. sodium chloride.
E. diamond.

52. Osmium tetroxide, OsO_4, is a soft crystal that melts at 40°C. The liquid does not conduct electricity. What kind of crystal is this?
A. Molecular Crystal
B. Covalent Crystal
C. Ionic Crystal
D. Metallic Crystal
E. Amorphous (Not a regular crystal)

53. The specific heat of liquid ethanol, $C_2H_5OH(l)$, is 2.46 J/g·°C and the heat of vaporization is 39.3 kJ/mol. The boiling point of ethanol is 78.3 °C. What amount of enthalpy is required to heat 50.0 g of liquid ethanol from 23.0 °C to ethanol vapor at 78.3 °C?
A. 179 kJ
B. 49.5 kJ
C. 42.7 kJ
D. 6840 kJ
E. 1970kJ

54.

Given that the heat of vaporization of diethyl ether is 26.0 kJ/mol and the vapor pressure of diethyl ether is 440 torr at 20.°C, calculate the normal boiling point of diethyl ether.

A. 38°C
B. 34°C
C. 32°C
D. 36°C
E. None of the above

55. Indicate all the types of intermolecular forces of attraction in $CH_3OH(l)$.
A. Ion-dipole and Hydrogen bonding
B. Dipole-dipole and Ionic
C. Hydrogen bonding and Dispersion
D. Dispersion and Dipole-dipole
E. Dispersion

56. The most space efficient arrangement of spheres is found in which type(s) of atom arrangement?
I. hexagonal close-packed
II. cubic close-packed
III. simple cubic
IV. body-centered cubic
A. II only
B. I and II
C. I, II, and IV
D. IV only
E. I only

57. Which one of the following substances crystallizes as a molecular solid?
A. SiO_2
B. Sn
C. $Al_2(SO_4)_3$
D. CH_3OH
E. KI

58. A face-centered cubic unit cell is the repeating unit in which type of crystal packing?
A. hexagonal close-packed
B. cubic close-packed
C. simple
D. all of the above
E. body centered

59. The atomic planes in a graphite crystal are separated by 335 pm. At what angle would you find the first-order (n = 1) diffraction of 0.154 nm X-rays from a graphite crystal?
A. 66.8°
B. 0.232°
C. 2.63°
D. 13.3°
E. 27.4°

60. $HOCH_2CH_2OH(s)$ is classified as a/an
A. ionic crystal.
B. metallic crystal.
C. covalent solid.
D. molecular crystal.
E. amorphous solid.