Chapter 11

Question 1

List the three states of matter in order of increasing molecular disorder.

gas < liquid < solid

gas < solid < liquid

solid < liquid < gas

liquid < gas < solid

liquid < solid < gas

Question 2

Identify the phase transition that occurs when CO_2 solid turns to CO_2 gas as it is heated.

deposition

vaporization

sublimation

freezing

condensation

Question 3

What is the significance of a line in a phase diagram?

The distinction between two phases disappears.

Three phases are in equilibrium.

Two phases are in equilibrium.

Only one phase is present.

Question 4

Rationalize the difference in boiling points between CH_2BrCl (68°C) and CH_3Br (3.5°C).

CH_2BrCl is more polarizable than CH_3Br.

CH_2BrCl can hydrogen bond.

CH_2BrCl has a dipole moment, and CH_3Br does not have a dipole moment.

CH_2BrCl does not have a dipole moment, and CH_3Br has a dipole moment.

CH_2BrCl is less polarizable than CH_3Br.

Question 5

When the pressure over a liquid is *decreased*, the boiling point of the liquid will
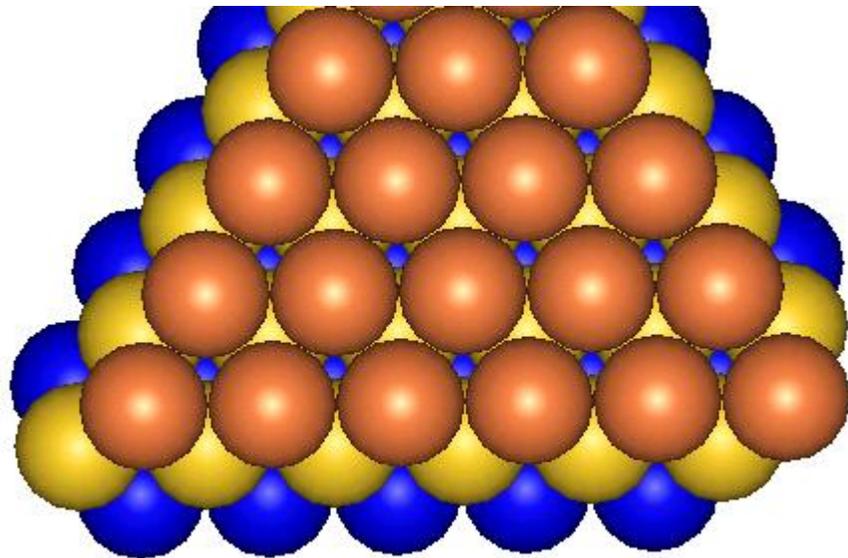
remain the same.

always decrease.

always increase.
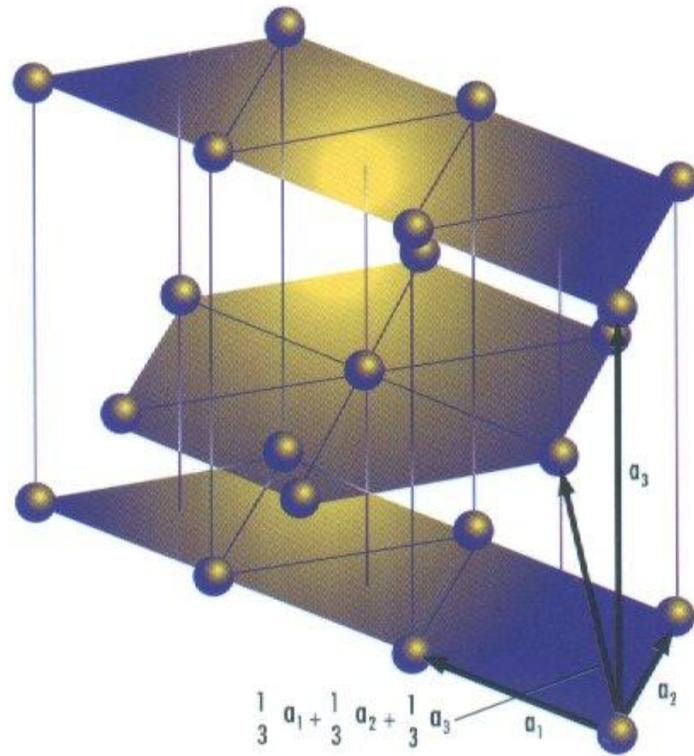
increase or decrease.

Question 6

What is the coordination number in close-packed structures?

6
12
2
4
8

$$\frac{1}{3}\,\mathbf{a}_1 + \frac{1}{3}\,\mathbf{a}_2 + \frac{1}{3}\,\mathbf{a}_3$$

$\mathbf{a}_1$ $\mathbf{a}_2$ $\mathbf{a}_3$

Question 7

Predict the boiling point of H_2Se if the following is true for the boiling points:

H_2O – 100°C

H_2Te – -2°C

H_2S – -61°C

It will have a boiling point of about -100°C.
It is impossible to estimate.
It will have a boiling point about -32°C (if linear interpolation with molar mass is done).
It will have a boiling point about 10°C.
It will have a boiling point about 110°C.

Question 8

What is H in kJ for the condensation of 25.0 g of CH_3OH at

25°C? (H_{vap} = 38.0 kJ/mol)

950 kJ
-950 kJ
-29.7 kJ
1.22×10^3 kJ
29.7 kJ

Question 9

What types of intermolecular forces can exist between neutral molecules?

dipole-dipole attraction, London dispersion, and hydrogen bonding
dipole-dipole attraction
London dispersion
ionic interaction
hydrogen bonding

Question 10

Arrange the following in terms of *decreasing* boiling points:

N_2, O_2, NO

$O_2 > N_2 > NO$

$N_2 > O_2 > NO$

$NO > N_2 > O_2$

$N_2 > NO > O_2$

$NO > O_2 > N_2$

Question 11

Indicate the type of crystal (molecular, metallic, covalent-network, or ionic) each of the following would form upon solidification: O_2, Mo, SiC

O_2 -- molecular; Mo -- ionic; SiC -- ionic

O_2 -- covalent-network; Mo -- metallic; SiC -- covalent-network

O_2 -- covalent-network; Mo -- metallic; SiC -- ionic

O_2 -- molecular; Mo -- metallic; SiC -- covalent-network

O_2 -- molecular; Mo -- metallic; SiC -- ionic

Question 12

Which of the following would have the highest vapor pressure at 0°C?

CH_2Cl_2

NH_3

CH_4

CH_3OH

H_2O

Question 13

Which one of the following will have the highest vapor pressure at a given temperature?

CH_3COOH

$C_{14}H_{30}$

C_5H_{10}

NaCl

H_2O

Question 14

Crystalline solids differ from amorphous solids in that crystalline solids have

a long-range repeating pattern of atoms, molecules, or ions.
much larger atoms, molecules, or ions.
atoms, molecules, or ions that are close together.
appreciable intermolecular attractive forces.
atoms, molecules, or ions that have no orderly structure.

Question 15

Which of these molecules can form hydrogen bonds?

$HOCH_3$
BH_3
PH_3
$N(CH_3)_3$
CH_3F

Question 16

Which one of the following is likely to be a liquid at room temperature?
(i) CH_4 **(ii)** Br_2 **(iii)** $NaCl$ **(iv)** H_2O **(v)** H_2S **(vi)** CH_3OH

iv and vi only
ii, iii, iv, and vi only
i and v only
iv, v, and vi only
ii, iv, and vi only

Question 17

Increasing the amount of liquid in a closed container will cause the vapor pressure of the liquid to

increase.
decrease.
remain the same.
It depends on the liquid.

Question 18

The reason that some insects can walk on water is due to

capillary action.

surface tension.

adhesive forces.

dishwashing detergent.

vaporization.

Question 19

Molecular nitrogen, N_2, and carbon monoxide, CO, are isoelectronic and nearly equal in molecular mass. Explain why the boiling point of CO is slightly higher than that of N_2.

N_2 has a larger dipole moment.

CO is less massive.

CO is more massive.

N_2 can hydrogen bond.

CO has a dipole moment.

Question 20

Which one of the following is an exothermic process?

melting

subliming

freezing

boiling

none of the above

Question 21

A substance above its critical temperature and pressure is known as a

liquid.

gas.

supercritical fluid.

super-cooled liquid.

none of the above

Question 22

Which one of the following statements is *incorrect*?

The higher the temperature, the more likely it is that a molecule has enough energy to escape into the gas phase.

Volatile liquids have relatively weak intermolecular forces.

The stronger the intermolecular forces, the higher the vapor pressure.

Vapor pressure is determined by a dynamic equilibrium of the liquid and the vapor.

Vapor pressure increases with temperature.

Question 23

How many of the following processes are exothermic?

1. freezing   (liquid to solid)
2. vaporization
3. sublimation
4. melting
5. condensation (gas to liquid)

1

2

3

4

5

Question 24

Which of the following statements is *incorrect*?

Three-dimensional covalent-network solids are easy to deform.

The layers in graphite are held together by dispersion forces.

Metals are easily deformed because the electrons can easily adapt to new configurations.

The melting point of an ionic solid should depend on the charge of the ions.

Buckyballs are molecular solids.

Question 25

Which types of intermolecular attractive forces operate between polar molecules?

London dispersion
London dispersion and dipole-dipole attraction
London-dispersion and hydrogen bonding
dipole-dipole attraction
hydrogen bonding

Question 26

The enthalpy of fusion of water is 6.0 kJ/mol and the heat capacity is 75 J/mol·°C. How many kJ of heat would it take to convert 50. g of ice at 0°C to liquid water at 22°C? (ΔH_{vap}= 38.0 kJ/mol)

4600 kJ
17 kJ
3.8×10^2 kJ
21 kJ
120 kJ

Question 27

In which case are adhesive forces involved?

hydrogen bonding in water
capillary action
surface tension
viscosity

Question 28

What kind of attractive forces must be overcome to sublime CO_2?

dipole-dipole attraction
hydrogen bonding
London dispersion
van der Waals forces
all of these

Question 29

Which of these molecules do *not* form hydrogen bonds?

diethyl ether, $CH_3CH_2OCH_2CH_3$

water, H_2O

ammonia, NH_3

ethylene glycol, $HOCH_2CH_2OH$

ethyl alcohol, CH_3CH_2OH

Question 30

Freon-11, which has the chemical formula CCl_3F, has a normal boiling point of 23.8°C. The specific heats of $CCl_3F(l)$ and $CCl_3F(g)$ are 0.87 J/g-K and 0.59 J/g-K, respectively. The heat of vaporization is 24.75 kJ/mol. Calculate the heat required to convert 10.0 g of Freon-11 from a liquid at -50.0°C to a gas at 50.0°C.

0.15 kJ

2.6 kJ

2.5 kJ

1.8 kJ

0.64 kJ

Question 31

Name two points on a phase diagram characterized by a unique value of temperature and pressure.

critical point and melting point

boiling point and triple point

boiling point and critical point

triple point and melting point

critical point and triple point

Question 32

Predict the order of the melting points (from highest to lowest) of NH_3, CH_4, SiH_4, and GeH_4.

$CH_4> SiH_4> GeH_4> NH_3$

$NH_3> GeH_4> SiH_4> CH_4$

$GeH_4> SiH_4> CH_4> NH_3$

$NH_3> SiH_4> CH_4> GeH_4$

$NH_3> CH_4> SiH_4> GeH_4$