CHAPTER 10 REVIEW

States of Matter

SECTION 1

SHORT ANSWER Answer the following questions in the space provided.

1. Identify whether the descriptions below describe an ideal gas or a real gas.

__________________  a. The gas will not condense because the molecules do not attract each other.

__________________  b. Collisions between molecules are perfectly elastic.

__________________  c. Gas particles passing close to one another exert an attraction on each other.

2. The formula for kinetic energy is \( KE = \frac{1}{2} mv^2 \).

a. As long as temperature is constant, what happens to the kinetic energy of the colliding particles during an elastic collision?

b. If two gases have the same temperature and share the same energy but have different molecular masses, which molecules will have the greater speed?

3. Use the kinetic-molecular theory to explain each of the following phenomena:

a. A strong-smelling gas released from a container in the middle of a room is soon detected in all areas of that room.

b. As a gas is heated, its rate of effusion through a small hole increases if all other factors remain constant.

4. a. ________________ List the following gases in order of rate of effusion, from lowest to highest. (Assume all gases are at the same temperature and pressure.)

(a) He  (b) Xe  (c) HCl  (d) Cl₂
b. Explain why you put the gases in the order above. Refer to the kinetic-molecular theory to support your explanation.

5. Explain why polar gas molecules experience larger deviations from ideal behavior than nonpolar molecules when all other factors (mass, temperature, etc) are held constant.

6. _____ The two gases in the figure below are simultaneously injected into opposite ends of the tube. The ends are then sealed. They should just begin to mix closest to which labeled point?

7. Explain the difference in the speed-distribution curves of a gas at the two temperatures shown in the figure below.
CHAPTER 10 REVIEW

States of Matter

SECTION 2

SHORT ANSWER Answer the following questions in the space provided.

1. Liquids possess all the following properties except
   (a) relatively low density.  (c) relative incompressibility.
   (b) the ability to diffuse.  (d) the ability to change to a gas.

2. a. Chemists distinguish between intermolecular and intramolecular forces. Explain the difference between these two types of forces.

   ________________________________________________________________
   ________________________________________________________________

   Classify each of the following as intramolecular or intermolecular:
   __________________________ b. hydrogen bonding in liquid water
   __________________________ c. the O—H covalent bond in methanol, CH₃OH
   __________________________ d. the bonds that cause gaseous Cl₂ to become a liquid when cooled

3. Explain the following properties of liquids by describing what is occurring at the molecular level.
   a. A liquid takes the shape of its container but does not expand to fill its volume.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

   b. Polar liquids are slower to evaporate than nonpolar liquids.
4. Explain briefly why liquids tend to form spherical droplets, decreasing surface area to the smallest size possible.

5. Is freezing a chemical change or a physical change? Briefly explain your answer.

6. Is evaporation a chemical or physical change? Briefly explain your answer.

7. What is the relationship between vaporization and evaporation?
CHAPTER 10 REVIEW

States of Matter

SECTION 3

SHORT ANSWER Answer the following questions in the space provided.

1. Match description on the right to the correct crystal type on the left.

   ______ ionic crystal  
   ______ covalent molecular crystal  
   ______ metallic crystal  
   ______ covalent network crystal  

   (a) has mobile electrons in the crystal  
   (b) is hard, brittle, and nonconducting  
   (c) typically has the lowest melting point of the four crystal types  
   (d) has strong covalent bonds between neighboring atoms

2. For each of the four types of solids, give a specific example other than one listed in the text.

   _________________________________________________________________  
   _________________________________________________________________  
   _________________________________________________________________  
   _________________________________________________________________  
   _________________________________________________________________  
   _________________________________________________________________  

3. A chunk of solid lead is dropped into a pool of molten lead. The chunk sinks to the bottom of the pool. What does this tell you about the density of the solid lead compared with the density of the molten lead?

   _________________________________________________________________

4. Answer amorphous solid or crystalline solid to the following questions:

   _______________________  a. Which is less compressible?
   _______________________  b. Which has a more clearly defined shape?
   _______________________  c. Which is sometimes described as a supercooled liquid?
   _______________________  d. Which has a less clearly defined melting point?

Original content Copyright © by Holt, Rinehart and Winston. Additions and changes to the original content are the responsibility of the instructor.
5. Explain the following properties of solids by describing what is occurring at the atomic level.
   a. Metallic solids conduct electricity well, but covalent network solids do not.

   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

   b. The volume of a solid changes only slightly with a change in temperature or pressure.

   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

   c. Amorphous solids do not have a definite melting point.

   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

   d. Ionic crystals are much more brittle than covalent molecular crystals.

   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

6. Experiments show that it takes 6.0 kJ of energy to melt 1 mol of water ice at its melting point but only about 1.1 kJ to melt 1 mol of methane, CH$_4$, at its melting point. Explain in terms of intermolecular forces why it takes so much less energy to melt the methane.

   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
CHAPTER 10 REVIEW

States of Matter

SECTION 4

SHORT ANSWER Answer the following questions in the space provided.

1. _____ When a substance in a closed system undergoes a phase change and the system reaches equilibrium,
   (a) the two opposing changes occur at equal rates.
   (b) there are no more phase changes.
   (c) one phase change predominates.
   (d) the amount of substance in the two phases changes.

2. Match the following definitions on the right with the words on the left.

   _____ Equilibrium    (a) melting
   _____ volatile        (b) opposing changes occurring at equal rates in a closed system
   _____ fusion          (c) readily evaporated
   _____ deposition      (d) a change directly from a gas to a solid

3. Match the process on the right with the change of state on the left.

   _____ solid to gas    (a) melting
   _____ liquid to gas    (b) condensation
   _____ gas to liquid    (c) sublimation
   _____ solid to liquid  (d) vaporization

4. Refer to the phase diagram for water in Figure 16 on page 347 of the text to answer the following questions:

   a. What point represents the conditions under which all three phases can coexist?

   b. What point represents a temperature above which only the vapor phase exists?

   c. Based on the diagram, as the pressure on the water system increases, what happens to the melting point of ice?

   d. What happens when water is at point A on the curve and the temperature increases while the pressure is held constant?
5. Use this general equilibrium equation to answer the following questions:

\[ \text{reactants} \rightleftharpoons \text{products} + \text{energy} \]

\[ \text{__________________} \]

a. If the forward reaction is favored, will the concentration of reactants increase, decrease, or stay the same?

\[ \text{__________________} \]

b. If extra product is introduced, which reaction will be favored?

\[ \text{__________________} \]

c. If the temperature of the system decreases, which reaction will be favored?

\[ \text{__________________} \]

6. Refer to the graph below to answer the following questions:

\[ \text{Vapor Pressure vs. Temperature for H}_2\text{O and CCl}_4 \]

\[ \text{[Graph showing vapor pressure vs. temperature for H}_2\text{O and CCl}_4] \]

\[ \text{__________________} \]

a. What is the normal boiling point of CCl\(_4\)?

\[ \text{__________________} \]

b. What would be the boiling point of water if the air pressure over the liquid were reduced to 60 kPa?

\[ \text{__________________} \]

c. What must the air pressure over CCl\(_4\) be for it to boil at 50°C?

\[ \text{__________________} \]

d. Although water has a lower molar mass than CCl\(_4\), it has a lower vapor pressure when measured at the same temperature. What makes water vapor less volatile than CCl\(_4\)?

\[ \text{________________________________________________________________} \]

\[ \text{________________________________________________________________} \]

\[ \text{________________________________________________________________} \]

\[ \text{________________________________________________________________} \]
CHAPTER 10 REVIEW

States of Matter

SECTION 5

SHORT ANSWER Answer the following questions in the space provided.

1. Indicate whether each of the following is a physical or chemical property of water.
   a. The density of ice is less than the density of liquid water.
   b. A water molecule contains one atom of oxygen and two atoms of hydrogen.
   c. There are strong hydrogen bonds between water molecules.
   d. Ice consists of water molecules in a hexagonal arrangement.

2. Compare a polar water molecule with a less-polar molecule, such as formaldehyde, CH₂O. Both are liquids at room temperature and 1 atm pressure.
   a. Which liquid should have the higher boiling point?
   b. Which liquid is more volatile?
   c. Which liquid has a higher surface tension?
   d. In which liquid is NaCl, an ionic crystal, likely to be more soluble?

3. Describe hydrogen bonding as it occurs in water in terms of the location of the bond, the particles involved, the strength of the bond, and the effects this type of bonding has on physical properties.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

4. The molar enthalpy of vaporization of water is 40.79 kJ/mol, and the molar enthalpy of fusion of ice is 6.009 kJ/mol. The molar mass of water is 18.02 g/mol.

__________________  a. How much energy is absorbed when 30.3 g of liquid water boils?

__________________  b. An energy unit often encountered is the calorie (4.18 J = 1 calorie). Determine the molar enthalpy of fusion of ice in calories per gram.

5. A typical ice cube has a volume of about 16.0 cm$^3$. Calculate the amount of energy needed to melt the ice cube. (Density of ice at 0°C = 0.917 g/mL; molar enthalpy of fusion of ice = 6.009 kJ/mol; molar mass of H$_2$O = 18.02 g/mol.)

__________________  a. Determine the mass of the ice cube.

__________________  b. Determine the number of moles of H$_2$O present in the sample.

__________________  c. Determine the number of kilojoules of energy needed to melt the ice cube.