Name ______________________________ Date ______________ Class ______________

CHAPTER 12 CHAPTER ASSESSMENT

States of Matter

Reviewing Vocabulary

Match the definition in Column A with the term in Column B.

Column A

_______ **1.** A measure of the resistance of a liquid to flow

_______ **2.** The energy required to increase the surface area of a liquid by a given amount

_______ **3.** Force per unit area

_______ **4.** The model describing the behavior of gases in terms of particles in motion

_______ **5.** An instrument used to measure atmospheric pressure

_______ **6.** A measure of the average kinetic energy of the particles in a sample of matter

_______ **7.** States that the total pressure of a mixture of gases is equal to the sum of the pressures of each gas in the mixture

_______ **8.** The temperature at which a crystalline solid becomes a liquid

_______ **9.** The pressure exerted by a vapor over a liquid

_______**10.** A graph that shows in which phase a substance exists under different conditions of temperature and pressure

_______**11.** Collisions between gas particles in which no kinetic energy is lost

_______**12.** The movement of one material through another

_______**13.** The process by which a substance changes from a gas or vapor to a solid without first becoming a liquid

_______**14.** A solid whose atoms, ions, or molecules are arranged in an orderly, geometric, three-dimensional structure

_______**15.** Temperature at which a liquid becomes a crystalline solid

_______**16.** States that the rate of effusion for a gas is inversely proportional to the square root of its molar mass

_______**17.** Temperature at which the vapor pressure of a liquid equals the external or atmospheric pressure

_______**18.** The process by which a solid changes directly to a gas without first becoming a liquid

_______**19.** A solid in which the particles are not arranged in a regular, repeating pattern

Column B

a. barometer

b. Dalton’s law of partial pressure

c. phase diagram

d. pressure

e. surface tension

f. temperature

g. elastic collisions

h. vapor pressure

i. viscosity

j. kinetic-molecular theory

k. melting point

l. Graham’s law of effusion

m. amorphous solid

n. deposition

o. boiling point

p. crystalline solid

q. sublimation

r. freezing point

s. diffusion

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Understanding Main Ideas (Part A)

In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.

______________ **1.** At a given temperature, all gas particles have the same *average kinetic energy*.

______________ **2.** A gas expands until it fills its container because its particles are in constant and *uniform* motion.

______________ **3.** Gases flow because there are *no significant* forces of attraction or repulsion between gas particles.

______________ **4.** The height that mercury reaches in the tube of a manometer *does not depend* on the diameter of the tube.

______________ **5.** *Unit cells* are compounds that lower the surface tension of water.

______________ **6.** A liquid is less fluid than a gas because the particles of a liquid have *greater* intermolecular forces.

______________ **7.** The viscosity of a liquid *does not depend* on the strength of intermolecular forces.

______________ **8.** The electrical conductivities of metallic solids are *better* than the conductivities of molecular solids.

______________ **9.** *Vaporization* is the point on a phase diagram that represents the temperature and pressure at which three phases of a substance can coexist.

______________ **10.** When vaporization occurs only at the surface of a liquid, the process is called *condensation*.

______________ **11.** The SI unit of pressure is the *atmosphere (atm).*

Answer the following questions.

12. What happens to the density of a gas as it is compressed? Why?

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13. Differentiate among dispersion forces, dipole–dipole forces, and hydrogen bonds.

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Understanding Main Ideas (Part B)

Answer the following questions.

1. A student produces carbon dioxide gas by heating calcium carbonate in a flask. She collects the gas by bubbling it into a test tube inverted in water. After filling the test tube, the student measures the pressure of the test tube's contents as 100.6 kPa at a temperature of 24.0°C. Find the partial pressure of carbon dioxide in the test tube. The partial pressure of water vapor at 24.0°C is 2.98 kPa.

2. Why are fountains often found in enclosed courtyards of houses in hot and dry countries? (Hint: evaporation requires energy.)

3. Rank the boiling points of water for each of the following locations in increasing order: Daytona Beach, Florida (altitude: sea level); Death Valley, Utah (altitude: 86 m below sea level); and Mount Shasta, California (altitude: 669 m). Explain your reasoning.

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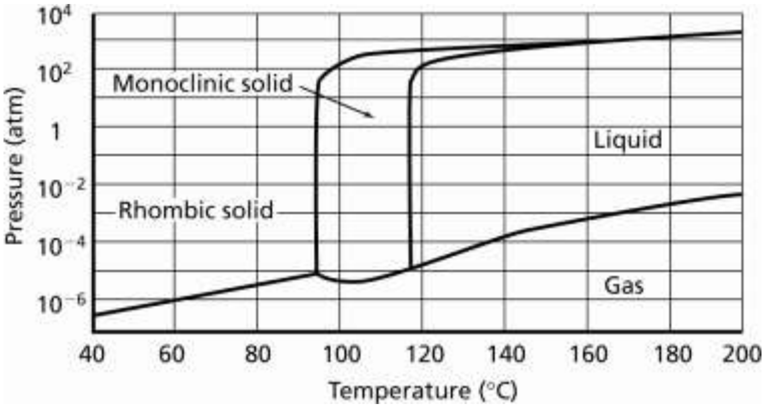
Thinking Critically

The graph below represents the phase diagram of sulfur. Solid sulfur (S_8) exists in two forms, monoclinic and rhombic. Use the graph to answer the questions.



1. How many phases of sulfur are represented in the phase diagram? What are they?

2. What is the phase of sulfur at a temperature of 100°C and a pressure of 1 atm?

3. What is the melting point of sulfur at a pressure of 1 atm?

4. What is the boiling point of sulfur at a pressure of 10^{-3} atm?

5. Under what conditions will monoclinic sulfur sublime?

6. How many triple points does sulfur have? Explain what a triple point is.

7. Explain a process that would convert liquid sulfur at a pressure of 1 atm into rhombic solid sulfur at 1 atm pressure without producing any monoclinic sulfur.

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Applying Scientific Methods

"This'll only take a few seconds," said the medical technician as he swabbed Emilio's middle finger. The technician took a small lancet and pricked the fingertip. Emilio watched as a small drop of blood formed. The technician wiped away the drop and placed a small, hollow glass tube over the fingertip. Blood quickly rose in the tube. "Finished," said the technician. Then he applied pressure to the tiny wound with a dry cotton ball.

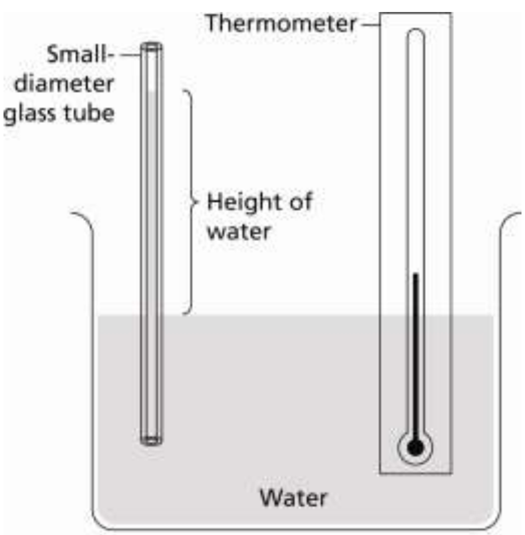
On the way home from the clinic, Emilio stopped for a soft drink. As he sat wondering about a topic for his independent science project, Emilio noticed the slight upward curve of the soft drink's surface where it touched the sides of the straw. He thought about investigating the movement of liquids through tubes. "Hmm. It's worth a try," he said to himself.

The next day, Emilio filled out the first two questions on the independent study form.

1. What question will your study investigate?
How does the diameter of a glass tube affect how high water rises in it?

2. What is the hypothesis?
Water rises higher in tubes with smaller diameters.

Over the next several weeks, Emilio wrote an approved procedure and collected some data. The figure on the left shows a simplified diagram of his experimental setup. The table shows some of his data.



Capillary Tube Diameter (mm)	Average Height of Water in Tube
0.40	7.44
0.60	4.96
0.80	3.72
1.00	2.98

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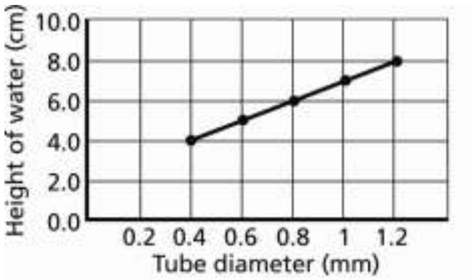
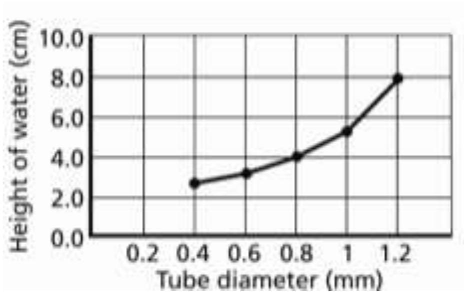
Applying Scientific Methods, *continued*

1. Which of the following graphs support Emilio's hypothesis? ______________________

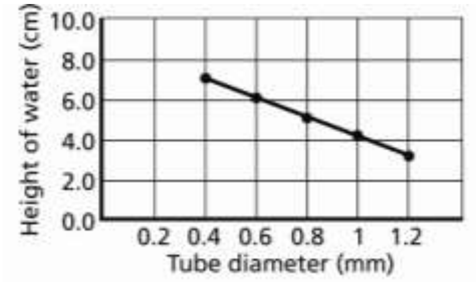
a.



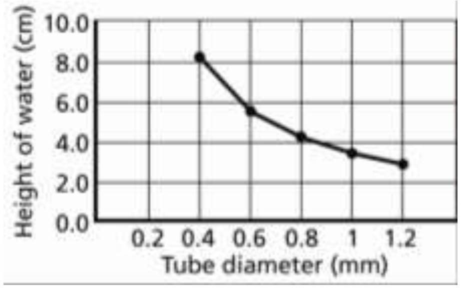
c.



b.



d.



2. Which of the graphs is supported by Emilio's data? ____________________________

3. In his research, Emilio learned that the height a liquid reaches in a capillary tube is directly related to the liquid's surface tension and inversely related to its density. When he repeated his experiment using ethanol (density = 0.788 g/mL), the height of the ethanol in each diameter tube was less than the height of the water. Use these observations to explain whether the surface tension of ethanol is greater or less than the surface tension of water.

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4. Emilio conducted a second experiment using a 0.60-mm diameter tube and water at temperatures of 20.0°C, 40.0°C, 50.0°C, and 70.0°C. He observed that there was a measurable decrease in the height of the water in the tube with increased temperature. Assuming that the change in density of the water is too small to affect the results, use your knowledge of intermolecular forces to explain Emilio's observations.

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Chapter Assessment - Chapter 12 – States of Matter

Reviewing Vocabulary

1. i
2. e
3. d
4. j
5. a
6. f
7. b
8. k
9. h
10. c
11. g
12. s
13. n
14. p
15. r
16. l
17. o
18. q
19. m

Understanding Main Ideas (Part A)

1. true
2. random
3. true
4. true
5. Surfactants
6. true
7. depends
8. true
9. Triple point
10. evaporation
11. pascal (Pa)
12. When a gas is compressed, its particles, which have not decreased in mass, occupy a smaller volume. Thus, the density ratio of mass to volume increases.
13. Dispersion forces are weak forces that result from temporary shifts in the density of electrons in electron clouds. Dipole–dipole forces are stronger attractions between oppositely charged regions of polar molecules. Hydrogen bonds are dipole–dipole attractions between molecules containing a hydrogen atom bonded to a small, highly electronegative atom with at least one electron pair.

Understanding Main Ideas (Part B)

1. $\text{Pressure}_{CO_2} = \text{Pressure}_{\text{TOTAL}} - \text{Pressure}_{H_2O}$

   $= 100.6 \text{ kPa} - 2.98 \text{ kPa} = 97.6 \text{ kPa}$
2. The water falling from the fountain is used to cool the courtyard. As the water from the fountain falls through the air, it evaporates. Evaporation requires energy, which comes from the surrounding air. The evaporation of the water cools the air in the courtyard by removing heat from it.
3. Mount Shasta, California; Daytona Beach, Florida; and Death Valley, Utah. Boiling point increases with increased air pressure. At an altitude above sea level, the column of atmospheric air that causes air pressure is shorter than at sea level. Because the column of air is shorter, its weight is less and the pressure it produces is less than the air pressure at sea level. Therefore, water will have a lower boiling point at an altitude higher than sea level. At an altitude below sea level, the column of atmospheric air is taller than at sea level. Because the column of air is longer, its weight is greater and the pressure it produces is greater than the air pressure at sea level. Therefore, water will have a higher boiling point at an altitude below sea level.

Thinking Critically

1. Four; gas, liquid, monoclinic solid, and rhombic solid
2. monoclinic solid
3. about 118°C
4. about 165°C
5. At pressures less than about 5×10^{-5} atm, monoclinic sulfur will sublime in the temperature range of 95°C–118°C.
6. Sulfur has three triple points. There are three points on the phase diagram where three different phases of sulfur coexist.

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7. One possible answer: Heat liquid sulfur to at least 165°C at 1 atm pressure. Then, keep the temperature constant and increase the pressure to at least 10^3 atm. At constant pressure, cool solid sulfur to a temperature below 95°C. At constant temperature, reduce the pressure to 1 atm.

Applying Scientific Methods

1. b and d
2. d
3. If the surface tension of ethanol and water were the same, the height of the ethanol in each tube should have been greater than the height of the water because ethanol is less dense than water. Because the height of the ethanol in each tube is less, ethanol's surface tension must be less than that of water.
4. The decreased height indicates that the surface tension of water decreases with increased temperature. At higher temperatures, the average kinetic energy of the water molecules is higher, which causes more movement of the molecules. Their increased motion reduces intermolecular attraction, which reduces surface tension.

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