CHAPTER 4 REVIEW ANSWERS

Reviewing Key Terms

1. Properties of water include clear (transparent), colourless, odourless, tasteless, liquid, slippery, melting point of 0°C, boiling point of 100°C.
2.

SOLID	LIQUID	GAS
Has a fixed shape	Takes the shape of its container	Takes the shape of its container
Has a fixed volume	Has a fixed volume	Has a volume that changes with its container

3. (a) Solid and liquid are two states of matter. For the same type of matter, liquid is the state that can result when a solid is heated; solid is the state that can result when a liquid is cooled.
   (b) Liquid and gas are two states of matter. For the same type of matter, gas is the state that can result when a liquid is heated; liquid is the state that can result when a gas is cooled.
   (c) Quantitative and qualitative properties provide different kinds of information for describing matter; one kind (quantitative) is more specific than the other because it can be described by a numeric value, but both kinds are important for giving the broadest possible range of descriptions.
   (d) Melting point and boiling point are the specific temperatures at which matter changes state when it is heated.
   (e) Mass and volume both measure quantities of matter.
   (f) Mass and density are both quantitative properties; density requires reference also to a specific volume of the sample.
   (g) Physical change and chemical change both describe alterations to matter and its properties.

Understanding Key Ideas

4. (a) Vinegar and water are clear (transparent), colourless, liquid, and slippery. Odour, melting point, boiling point, and/or density could be used to tell them apart.
   (b) Soil and instant coffee may have the same colour, are granulated, and are solid. Odour and texture could be used to tell them apart. (Some students might also suggest mixing them with water.)

4 Review

Key Terms

chemistry
matter
property
quantitative property
qualitative property
states of matter
solid
liquid
gas
temperature
melting point
boiling point
mass
volume
density
physical change
model
particle model of matter
chemical change
chemical property

Reviewing Key Terms

If you need to review, the section numbers show you where these terms were introduced.

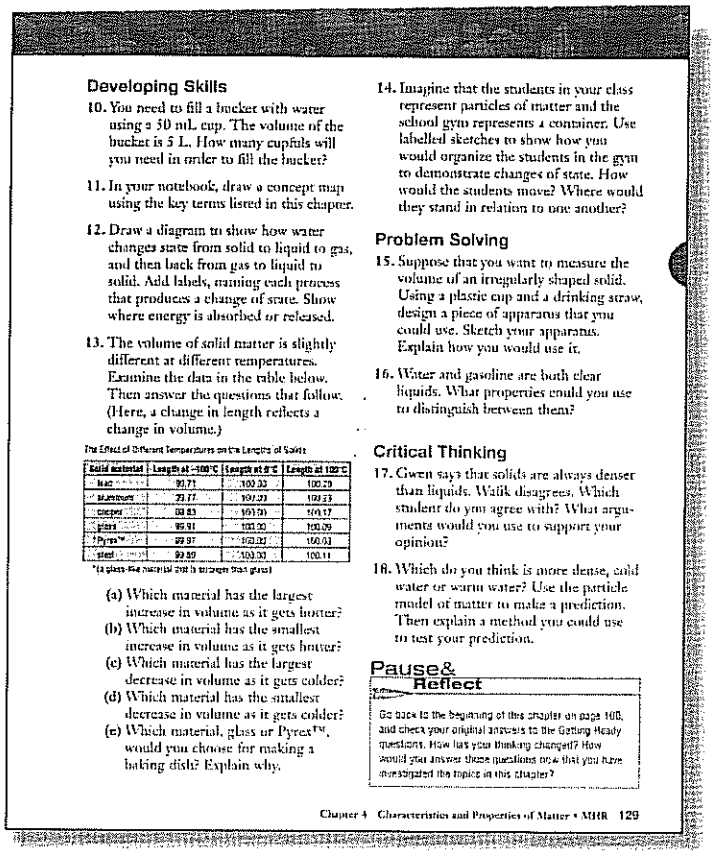
1. What are three properties of water? (4.1)
2. Divide a sheet of paper into three columns. Label the columns "Solid," "Liquid," and "Gas." In each column, write one statement that always applies to the shape of matter in this state. Then write one statement that always applies to the volume of matter in this state. (4.1)
3. For each of the following, what is the relationship between the two terms?
   (a) solid and liquid (4.1, 4.3)
   (b) liquid and gas (4.1, 4.3)
   (c) quantitative property and qualitative property (4.1)
   (d) melting point and boiling point (4.1)
   (e) mass and volume (4.2)
   (f) mass and density (4.2)
   (g) physical change and chemical change (4.3)

Understanding Key Ideas

Section numbers are provided if you need to review.

4. For each of the following, what properties do the two materials have in common? What properties would you use to tell one from the other? (4.1, 4.2, 4.3)
   (a) water and vinegar
   (b) soil and instant coffee
   (c) glass and ice
   (d) air and carbon monoxide
5. What properties would you use to describe a baseball? (4.1)
6. What formula shows how mass, volume, and density are related to each other? What does each symbol in this formula represent? (4.2)
7. What units would you use to describe each of the following? (4.1, 4.2)
   (a) the mass of a sugar cube
   (b) the volume of liquid in a tablespoon
   (c) the volume of lemonade in a pitcher
   (d) the mass of a bicycle
   (e) the melting point of copper
   (f) the density of ocean water
   (g) the density of air
   (h) the density of an iron nail
8. How are mass, volume, and density related? (4.2)
9. How would you use the particle model of matter to describe each of the following? (4.3)
   (a) the spacing between the particles in a solid
   (b) the movement of the particles in a gas
   (c) the movement of the particles in a solid
   (d) the spacing and movement of the particles in a liquid

   (c) Glass and ice are solid, clear, colourless, and odourless. Melting point, density, and feel/texture could be used to tell them apart.
   (d) Air and carbon monoxide are clear, colourless, odourless, and gaseous. Density and boiling point could be used to tell them part.
5. Students may suggest properties related to shape, size, texture, and colour. Few quantitative properties are likely.
6. Mass, volume, and density are related by the formula $D = \frac{m}{v}$. D represents density; m is for mass; v is for volume.
7. In theory, any mass or volume units are correct. However, look for students to use units that are appropriate to the amount or size of the object in each case:
   (a) mg
   (b) mL
   (c) L (or mL)
   (d) kg
   (e) °C
   (f) kg/L (or kg/m^3)
   (g) g/mL (or kg/L)
   (h) g/cm^3
8. They are related by the fact that density measures the amount of matter (mass) that occupies a specific space (volume).



Developing Skills

10. You need to fill a bucket with water using a 50 mL cup. The volume of the bucket is 5 L. How many cupfuls will you need in order to fill the bucket?
11. In your notebook, draw a concept map using the key terms listed in this chapter.
12. Draw a diagram to show how water changes state from solid to liquid to gas, and then back from gas to liquid to solid. Add labels, naming each process that produces a change of state. Show where energy is absorbed or released.
13. The volume of solid matter is slightly different at different temperatures. Examine the data in the table below. Then answer the questions that follow. (Here, a change in length reflects a change in volume.)

The Effect of Different Temperatures on the Lengths of Solids

Solid material	Length at −100°C	Length at 0°C	Length at 100°C
lead	99.71	100.00	100.29
aluminum	99.77	100.00	100.23
copper	99.83	100.00	100.17
glass	99.91	100.00	100.09
Pyrex™	99.97	100.00	100.03
steel	99.89	100.00	100.11

*(a glass-like material that is stronger than glass)

(a) Which material has the largest increase in volume as it gets hotter?
(b) Which material has the smallest increase in volume as it gets hotter?
(c) Which material has the largest decrease in volume as it gets colder?
(d) Which material has the smallest decrease in volume as it gets colder?
(e) Which material, glass or Pyrex™, would you choose for making a baking dish? Explain why.

14. Imagine that the students in your class represent particles of matter and the school gym represents a container. Use labelled sketches to show how you would organize the students in the gym to demonstrate changes of state. How would the students move? Where would they stand in relation to one another?

Problem Solving

15. Suppose that you want to measure the volume of an irregularly shaped solid. Using a plastic cup and a drinking straw, design a piece of apparatus that you could use. Sketch your apparatus. Explain how you would use it.
16. Water and gasoline are both clear liquids. What properties could you use to distinguish between them?

Critical Thinking

17. Gwen says that solids are always denser than liquids. Wafik disagrees. Which student do you agree with? What arguments would you use to support your opinion?
18. Which do you think is more dense, cold water or warm water? Use the particle model of matter to make a prediction. Then explain a method you could use to test your prediction.

Pause & Reflect

Go back to the beginning of this chapter on page 108, and check your original answers to the Getting Ready questions. How has your thinking changed? How would you answer these questions now that you have investigated the topics in this chapter?

9. (a) In a solid, particles have very little space between them.
   (b) In a gas, the particles are moving very quickly.
   (c) In a solid, the particles are vibrating in place.
   (d) In a liquid, the particles are spaced close together, but there is enough space between them to move past each other.

Developing Skills

10. 100 cupfuls are needed.
11. Numerous concept maps are possible. Assess students' maps on the basis of *conceptual* links, rather than "narrative" or descriptive links. (That is, look for how the ideas are connected, rather than for strings of key terms that are linked with phrases that make them form sentences.)
12. Encourage students to create their own diagrams, rather than copy the diagram on page 123 of the textbook.
13. (a) lead
    (b) Pyrex™
    (c) lead
    (d) Pyrex™
    (e) Pyrex™ is a better choice because its volume changes much less as it is heated and cooled.
14. This task may be more effective for many students if they act it out, rather than sketch their ideas. If possible, have students do both.

Problem Solving

15. Students must think about displacement, and about a way to collect water that is displaced when the solid is immersed. If the straw is inserted into the side of the cup, and water added to just under the straw, any displaced water will flow out of the straw. Collecting the displaced water and measuring its volume provides the volume of the solid.
16. Students likely will say they could distinguish between the two liquids by smell. However, since the distinctive gasoline smell is the result of an additive, a different property would be needed. Density is one option. Another is flammability; *however*, using that property would be very dangerous, so adequate safety measures would need to be taken.

Critical Thinking

17. Based on their experiences with Investigation 4-E, students have ample evidence to justify agreeing with Wafik.
18. Since adding heat makes particles move faster and farther apart, warm water should be less dense than cold water, because the same amount of warm water occupies a larger space (has a larger volume). One way to test this prediction is to have a sample of cold water, a sample of hot water with food colouring added to it, and mix them. If hot water is less dense than cold water, the coloured hot water should float on top of the cold water. (Students will test this in Chapter 7, Investigation 7-C: Movement in the Mantle.)