CHAPTER 5

Review

SUGGESTED ANSWERS

WHAT DO YOU REMEMBER?

1. Clues that indicate a chemical change would include a change in colour (e.g., bread becomes darker in colour as its toasted), light being emitted (e.g., magnesium burns brightly), a change in odour (e.g, the aroma of steak changes as it is being grilled), a reaction producing a gas or precipitate (e.g., antacid tablets fizz when added to water), or a change in thermal energy (e.g., a burning marshmallow radiates heat).
2. There are several physical changes that can be made to a silver spoon. You can bend or cut the spoon into another shape or object. You can also melt the silver into a liquid. All of these changes are physical changes because the spoon's state or shape changes but the chemical composition of the silver is not altered.
3. Density, boiling point, and melting point are quantitative characteristic properties of water. They are considered characteristic because all of these quantities are unique only to water. A substance without these exact characteristics cannot be considered water.
4. Unlike most substances, water expands when it freezes, making it less dense. This means that ice is more buoyant than water. In lakes, the frozen sections of ice rise to the top of the water, allowing aquatic animals and fish to exist beneath the surface during the winter months.
5. WHMIS stands for Workplace Hazardous Materials Information System.
6. **(a)** The WHMIS symbol for explosive (combustible) materials is a large circle containing a flame.
   (b) The WHMIS symbol for poisonous and infectious materials causing immediate and serious toxic effects is a skull with two cross bones running through it.
   (c) The WHMIS symbol for corrosive materials is two test tubes pouring a burning liquid onto a table and set of hands.
   (d) The WHMIS symbol for flammable materials is a large flame sitting on top of a horizontal line.

WHAT DO YOU UNDERSTAND?

7. **(a)** It is a qualitative property because it is a shape and cannot be measured.
   (b) It is a quantitative property because mass is a defined measurement.
   (c) It is a qualitative property because taste cannot be quantified.
   (d) It is a quantitative property because diameter is a defined measurement.
   (e) It is a qualitative property because melted icing is not a quantifiable property.
8. Pure water has a freezing point of 0 °C. When an impurity such as salt is added to this water ,it interferes with freezing and causes allows the salt water solution to remain a liquid at much lower temperatures.
9. The density of a substance is defined at a given temperature because it varies as temperature changes. An increase in temperature generally causes a substance to expand, resulting in an increase in volume. As volume increases, density decreases. Conversely, a decrease in temperature causes a substance to contract, resulting in a decrease in volume an increase in density.
10. **(a)** Physical. There is no change in colour or odour, and the substance did not produce any gas or precipitate. It is simply gaining thermal energy and becoming less viscous.
    (b) Physical. The change in colour was not related to any chemical reaction, it is simply covered on its exterior by coloured paint particles.

(c) Physical. This type of mixture is called a solution, and both substances can be returned to their original states.

(d) Chemical. The egg whites undergo a chemical reaction producing a new aroma, consistency, and causing them to change in colour, optical clarity, and state.

(e) Physical. The wood is simply rearranged into smaller pieces; no new substances are created.

(f) Chemical. Burning the wood is a reaction that breaks down the chemical bonds of the wood creating ash and gases, both of which are new substances.

(g) Chemical. This is a chemical interaction that produces gas bubbles and cannot be reversed.

SOLVE A PROBLEM

11. This is a chemical change because it produces a gas product and alters the colour of the crystals. It is also irreversible, as are most chemical changes.

12. This is a physical change. The material is merely changing state, as evidenced by the fact that substance can be reformed back into its original condition.

13. A simple procedure would be to identify the melting point of gold, and heat both substances to exactly that temperature. If the substance in question melts before or after the designated melting point then we can be sure that it is not real gold. Alternatively, you could determine the density of the sample to see if it matches the density of gold. This involves two steps. First, use a scale to determine the mass of the sample. Its volume could be determined by adding the sample to a graduated cylinder half-filled with water. The rise in the water level equals the volume of the sample. To determine density, divide mass by volume.

14. (a) The independent variable is the amount of salt in the water. The dependent variable is the boiling point.

(b) The variables that need to be controlled are the amount of water, the amount and type of salt, the size and shape of the pot, the temperature of the room, and the amount of heat that is applied.

(c) The y-axis will denote temperature, while the x-axis will denote time.

(d) If the results do not support the hypothesis, the experiment was still successful because I know something I did not know before. Specifically, that either the given amount of salt I used was not enough to change the boiling temperature of water, or that salt does not affect the boiling temperature of water.

15. (a) You can recycle old phone books in the same manner that one would use to recycle other paper.

(b) You could use the Internet to find phone numbers and business listings. Phone book companies could recycle old phone books into new phone books, so that no new paper is being used.

16. The mass is 69 g.

17. The density is 6.857 kg/L.

18. The density is 0.751 g/mL, which is less dense than water. Therefore, the piece of wood would float.

19. The volume is 187 cm^3.

CREATE AND EVALUATE

20. (a) My recipe will include the following ingredients: 3 strips well-done grilled chicken; 3 hard-boiled eggs; 2 whole roasted peppers; a head of romaine lettuce; 60 mL Italian salad dressing. Mix all ingredients until they are relatively consistent throughout to form a salad. The chicken underwent a chemical reaction from the grilling process and changed colours from pink to white, as well as producing a strong aroma. The peppers reacted to the heat from being roasted and have undergone a chemical change as evidenced by the fact that they now have a much sweeter taste than before and turned colour. The eggs clearly underwent a chemical change as the egg whites (protein matter) changed colours and clarity (from clear and colourless to opaque and white). The egg also changed from liquid to solid. This was a chemical change as it cannot be changed back into a liquid. The salad dressing is a physical solution as numerous ingredients are combined, and the salad forms a mechanical mixture with all of the aforementioned ingredients to form a salad.

(b) It is very important to cook all items very thoroughly, especially the chicken and the eggs. If they are cooked in an incomplete manner, the chemical changes that are necessary will not take place and dangerous bacteria may be present in these items. Likewise, incomplete cooking of the peppers will not produce the flavor you are looking for. Failure to properly mix the salad with the remaining items will leave you with an unbalanced array of ingredients that do not work well together.

(c) Recipes will vary. Sample answer: Prosciutto, red pepper, avocado, olive oil and vinegar dressing, and melted fresh mozzarella sandwich on a wheat ciabatta. The changes are all physical changes that take place in making this sandwich: cutting the prosciutto, red pepper, and cheese; stirring the dressing; melting the cheese.

REFLECT ON YOUR LEARNING

21. Many chemicals that are deemed as useful in our society may actually have negative consequences on the environment. Putting too much salt on the road increases road safety in the winter, but may damage nearby soil and vegetation. Gardening chemicals designed to promote plant growth may seep into the groundwater and become hazardous to the environment. Pesticides may be useful in allowing us to control pest populations and produce greater quantities of crops, but may also kill beneficial species as some of this poison travels through our environment.

WEB CONNECTIONS

22. (a) It is impractical because it is so cold that the water still freezes and little benefit is obtained from applying salt.

    (b) Two alternatives to road salt are sand and kitty litter, both of which minimize damage to the environment and have been shown to safely de-ice the roads in wintertime.

23. Sample answers:

    (a) In the past, lead was used to line aqueducts and water pipes. It was also used as a paint pigment and gasoline additive.

    (b) Lead has been used for centuries in a variety of applications. It was one of the earliest widely used metals because it was easy to extract from the ground and work with. The high malleability of lead made it easy for ancient cultures to mould and shape it into a variety of useful applications. The ancient Romans, for example, lined the surfaces of water carrying aqueducts with lead. In the early 20th century, water pipes in homes were often made of lead because it could be easily shaped. Lead compounds were also used as pigments in paints because their colours were desirable. Lead compounds also made the paint last longer while maintaining its fresh appearance. Other lead compounds were used as an additive in gasoline during the 1970's and 1980's to improve the burning characteristics of the gasoline.

    (c) The symptoms of lead poisoning include delays in brain and nervous system development. Higher exposure to lead can result in kidney failure, low sperm count, and miscarriages.

CHAPTER 5

Self-Quiz

SUGGESTED ANSWERS

1. (b); Choice (b) is correct. Salt dissolved in water is a solution because it forms a clear, uniform mixture. Choice (a) is incorrect. Sand is a mechanical mixture, because you can see different types of matter in a pile of sand. Choice (c) is also incorrect. Orange juice is a mechanical mixture because it is opaque. In some types of orange juice, you can see pieces of pulp. Choice (d) is incorrect because granola is a mechanical mixture with different substances that are easily distinguishable.
2. (d); Choice (d) is correct. When a substance burns, it undergoes a chemical change as its composition changes. Choices (a), (b), and (c) are incorrect because colour, density, and boiling point are physical properties of a substance and can be determined without changing the composition of the substance.
3. (a); Choice (a) is correct. Density is the amount of matter per unit volume of that matter. Choices (b), (c), and (d) are incorrect because density is not defined by any of those ratios.
4. (c); Choice (c) is correct. A piece of pure gold contains only gold particles. Choices (a), (b), and (c) are incorrect because they are all made up of different types of particles. Wood includes plant cells and water. Apples include carbohydrates, water, and small amounts of other particles. Paper includes cellulose fibres, filler, and various additives.
5. False. A qualitative property does not provide numerical information about a substance. The mass of a substance is numerical information. A true version of the statement would be: "The mass of a substance is an example of a quantitative property."
6. True. Any impurity added to water interferes with the freezing process. As a result, adding salt to water lowers the freezing temperature of the water.
7. Faster. As a substance is heated, its particles gain energy. The more energy they have, the faster the particles move.
8. Physical. When salt is dissolved in water, the salt particles spread farther apart, but they do not react to form a new substance. Because the salt particles have changed their form but not their composition, they have undergone a physical change.
9. **(a)**(iv) An object that has a high lustre is very shiny. An object that has a low lustre appears dull; **(b)**(i) A substance that resists flowing has a high viscosity. A substance that flows easily has a low viscosity; **(c)**(ii) A substance, such as copper, that can be pulled into thin wires is considered ductile; **(d)**(iii) Glass breaks easily and does not bend, so it is considered brittle; **(e)**(v) Silver and gold can be hammered into thin sheets when making jewellery, so they are considered malleable.
10. Sample answer: The hamburger changes colour from pink to brown as it cooks. This colour change is a sign of a chemical change.
11. Sample answer: A metal used in making pots and pans for cooking should be malleable, be a good conductor of heat, and have a very high melting point.
12. 5 g of liquid gold occupies more space than 5 g of solid gold. In the liquid state, particles of a substance are generally farther apart than they are in the solid state. Therefore, the 5 g of liquid gold particles takes up more space than the 5 g of solid gold particles.
13. Temperature is a physical property because it gives information about the amount of energy in the particles of a substance. Temperature is not a characteristic physical property because many different substances can be at the same temperature. A characteristic physical property is a physical property that is unique to a substance and can be used to identify the substance.

14. Sample answer: solid mixture—breakfast cereal; liquid mixture—tap water; gas mixture—air

15. Sample answer: $D = \frac{m}{v} = \frac{12.15\ \text{g}}{4.5\ \text{cm}^3} = 2.7\ \text{g/cm}^3$

16. Sample answer: $D = \frac{m}{v}$; $m = DV = 0.97\ \text{g/cm}^3 \times 2.6\ \text{cm}^3 = 2.5\ \text{g}$

17. Sample answer: First, I would use a magnet to attract the pieces of iron and separate them from the mixture. Next, I would pour the mixture of sawdust and pieces of rock into a pail of water. The rocks will sink to the bottom of the pail because they are denser than water, but the sawdust will float on the water because it is less dense than water. I would then skim the sawdust off the water surface with a fine net, and finally retrieve the rocks from bottom of the pail.

18. Sample answer: My friend is incorrect. The tree limbs have undergone a physical change. The small pieces that come out of the chipper are still pieces of the tree. They have changed only in physical appearance, but they have not been transformed into different substances.

19. Sample answer: Sea water contains more dissolved salt than fresh water. Any substance dissolved in water interferes with how the water particles come together as they freeze into a solid. Therefore, salt dissolved in sea water will lower the freezing point of sea water, causing it to freeze at lower temperatures than fresh water.

20. Students' articles may include the following points: the dissolving power of water; the fact that its solid form is less dense than its liquid form, so ice floats on liquid water; the fact that all living organisms need and consume water.

21. Sample answer: Some of my qualitative properties are that I have red hair and blue eyes. An example of a quantitative property is that I am 5 feet 7 inches tall.

22. Sample answer: Heating canned soup is a physical change. By heating the soup, I am adding thermal energy to make it hot, but I am not changing the substances in the soup into other substances. Toasting bread involves a chemical change. By toasting the bread, I am changing the soft, white bread into a dry, crispy, brown material. The bread has undergone a chemical change, similar to burning.

23. Sample answer: If you lower the temperature of pure, liquid water to 0 °C, the liquid will freeze to form a solid. If you raise the temperature of ice made from pure water to 0 °C, the solid ice will melt and turn into liquid water. Therefore, the freezing point and the melting point of pure water is the same temperature: 0 °C.

24. The piece of copper would float in liquid mercury because copper is less dense than the mercury.

25. **(a)** Physical; **(b)** chemical; **(c)** chemical; **(d)** physical; **(e)** physical.

26. **(a)** Carbon fibre, being less dense than aluminum, is an advantage for racing bicycles because the same amount of material would be lighter, and the lighter the bicycle, the faster it can go.

    (b) Carbon fibre should have the physical properties of being hard but not brittle, so it would not break easily if the bicycle fell over. It should have the chemical property of not oxidizing easily so that the bicycle will not rust easily.

27. The heat of the water will increase the kinetic energy of the air molecules inside the ball, thus increasing the pressure, which will be sufficient to pop out the dents.

28. **(a)** A gas can be compressed, whereas a liquid and a solid cannot. A large amount of propane gas can be taken home in a small container because of its compressibility.

    (b) A chemical property of barbeque fuel is that it burns completely in the presence of oxygen to form carbon dioxide and water. It does not leave soot on our food.