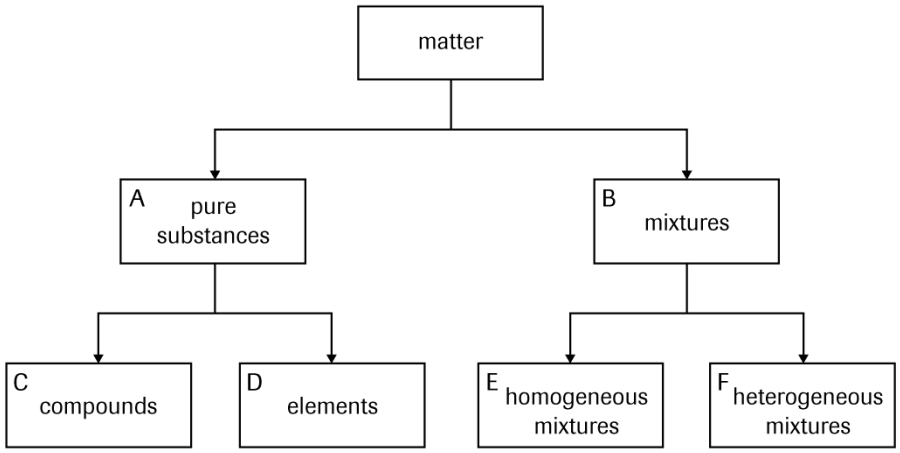
UNIT 4 CHEMISTRY IN THE ENVIRONMENT

ARE YOU READY?

(Pages 262–265)

Knowledge and Understanding

1. (a) A colour change in **Figure 1(a)** indicates that a chemical reaction has taken place.
   (b) The production of gas bubbles in **Figure 1(b)** indicates that a chemical reaction has taken place.
   (c) The formation of a precipitate in **Figure 1(c)** indicates that a chemical reaction has taken place.
2.



3. **Table 1** Classification of Matter

Substance	A or B	C or D or E or F
vinegar	B	E
pure water	A	C
sulfur	A	D
air	B	E
drinking water	B	E
smog	B	E or F
lye (sodium hydroxide)	A	C

4. The balloon will expand as it rises. A closed balloon will burst, while an open balloon will rise to a predetermined altitude. Either situation is explained using the pressure inside and outside the balloon.
5. As the hot-air balloon rises, the operator ignites the burner to maintain the volume of air in the balloon. The burner increases the temperature of the air in the balloon, thus increasing the kinetic energy of the air molecules. As a result, the air molecules will occupy a greater volume in the balloon. Carbon dioxide gas, which is produced during combustion, is also added to the air mixture in the balloon, thus increasing the total number of air molecules in the balloon.
6. (a) The three states of matter that can be seen are solid (sucrose), liquid (solution), and gas (air).
   (b) We know that the solution is unsaturated from day 1 to day 5 because the crystal has decreased in size.
   (c) The sugar crystal stayed the same size from day 5 to day 7 because the solution reached saturation by day 5. No additional sugar will dissolve into solution.
   (d) We know that the solution is saturated between day 8 and day 11 because, as the liquid evaporates, the sugar begins to crystallize. Since the sugar is crystallizing out of solution, the solution must be saturated.

7. (a) $Mg_{(s)} + 2\ HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$
   (b) This reaction represents a single displacement reaction.
8. (a) $2\ KClO_{3(s)} \rightarrow 2\ KCl_{(s)} + 3\ O_{2(g)}$
   (b) $4\ Fe_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)}$
   (c) $N_{2(g)} + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}$
9. (a) Two moles of solid potassium chlorate react to produce two moles of solid potassium chloride and three moles of oxygen gas.
   (b) Four moles of solid iron react with three moles of oxygen gas to produce two moles of solid iron(III) oxide.
   (c) One mole of nitrogen gas reacts with three moles of hydrogen gas to produce two moles of ammonia gas.
10. (a) An acid is a water-soluble substance that turns blue litmus red in solution. Acidic solutions also taste sour and neutralize bases. According to Arrhenius' theory, an acid is a molecular compound that ionizes with water to form hydrogen ions in solution. A base is a water-soluble substance that turns red litmus blue in solution. A basic solution tastes bitter and feels slippery. According to Arrhenius' theory, a base is an ionic compound that dissociates in water to produce hydroxide ions.
    (b) Acetic acid in vinegar is a weak acid, while hydrochloric acid is a strong acid. Since a strong acid ionizes more readily in solution than a weak acid of the same concentration, vinegar is safer to consume than hydrochloric acid.
11. $CO_{2(g)} + H_2O_{(l)} \rightarrow H_2CO_{3(aq)}$
12. (a) $NaOH_{(aq)} + HCl_{(aq)} \rightarrow H_2O_{(l)} + NaCl_{(aq)}$
    (b) This reaction represents a double displacement reaction. It also is a neutralization reaction.

Inquiry and Communication

13. To make the chalk react with the hydrochloric acid faster, you could increase the temperature, increase the concentration of hydrochloric acid, or crush the chalk into smaller pieces to increase the surface area.
14. Student answers may vary. One possible experiment to determine the effect that altitude has on the boiling point of pure water would involve determining the temperature at which water boils at different altitudes and comparing these temperatures.

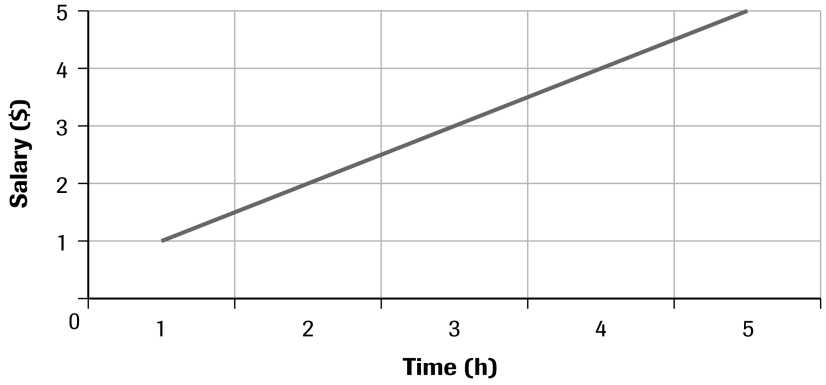
    For this experiment, the independent variable is the altitude, the dependent variable is the temperature at which water boils, and the controlled variables are the amount of water used and the amount of heat applied to water.

Making Connections

15. The commissioner's reasoning may appear to be correct. Summerville's water supply does appear to be too acidic, however. The pH of pure water is 7 and, thus, a pH of 5.7 is over ten times more acidic than pure water. Although people may consume small amounts of acidic foods and beverages, such as salad dressing and soft drinks, people consume large amounts of water. People were complaining about the taste of the acidic water, and it may be inappropriate for other uses, such as washing clothes, bathing, and watering plants.
16. (a) CFCs were used widely as refrigerants and propellants in aerosol cans.
    (b) When CFCs are released, they rise to the stratosphere where they readily react with ozone, $O_{3(g)}$, to form oxygen, $O_{2(g)}$. This depletion of the ozone layer allows more dangerous ultraviolet radiation to reach Earth's surface. Exposure to UV radiation is a health hazard.
17. Student answers may vary. One example is pulp and paper mills, which may use large amounts of mercury. Mercury was released in large quantities into nearby water bodies in the belief that it would be sufficiently diluted. Many species of marine life, however, now contain high levels of mercury. Mercury has become concentrated in many levels of the marine food chain.

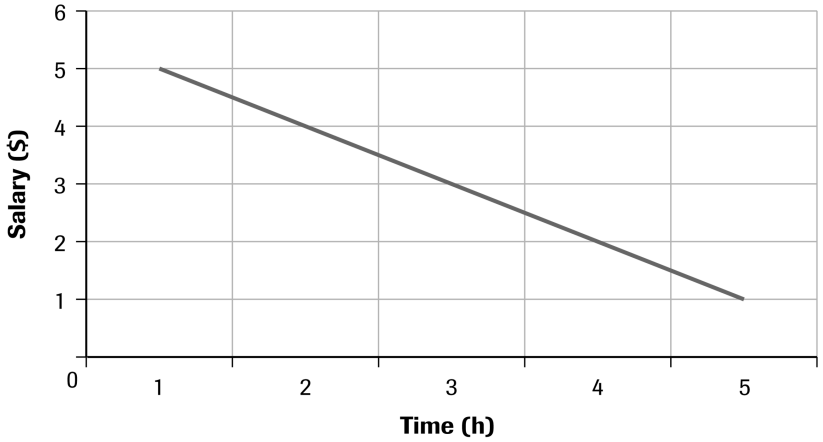
Math Skills

18. (a)



(b) The slope of the line represents the salary earned per unit time ($/h).

(c) No, I would not want to work at this job because the more hours I worked, the less I would get paid.



Technical Skills and Safety

19. (a) If a chemical solution spills onto exposed skin, you should drench the area with a continuous flow of water for 30 min and immediately inform your teacher.

(b) The WHMIS symbol for a corrosive substance shows a test tube dripping a substance on a solid and a test tube dripping a substance on a human hand.

20. The first symbol represents flammable and combustible materials, or materials that will continue to burn after being exposed to a flame or other ignition source. The second symbol represents compressed gas, or material that is gaseous and kept in a pressurized container. The third symbol represents oxidizing materials, or materials that cause other materials to burn or support combustion.

21. **Table 3** Types of Fire Extinguishers

	Class of fire extinguisher		
Class of fire	**Class A water**	**Class B carbon dioxide**	**Class C dry chemical**
A (wood, paper, cloth)	✓	✓	✓
B (flammable liquids)		✓	✓
C (live electrical equipment)			✓