Get Ready for Unit 2

Atoms, Elements, and Compounds

Answers for page 48

Multiple Choice

1. d

2. e

3. a

4. d

5. e

6. c

7. c

8. b

Answers for page 49

Written Answer

9. All particles that make up a particular pure substance are the same.

10. The higher the temperature, the faster the particles move.

11. States of Matter for Water in Different Locations

Location	State of Matter for Water
Ocean	liquid
Glacier	solid
Atmosphere	gas

12. The volume of the gas increases.

13. a. Solids and liquids have definite volumes. **b.** Solids have definite shapes. **c.** Gases completely fill any container. **d.** Gases and liquids flow. **e.** Solids are held together in a rigid structure. **f.** Liquids and solids are made of particles that are close together; although solid particles are closer together than liquid particles.

14. Gases are more compressible than liquids are.

15. Mechanical mixtures do not have a uniform distribution of components, and they can be solids, liquids, or gases. It is often easy to see the different components of mechanical mixtures. Solutions are homogeneous mixtures that look like one substance.

16. The volume does not change, because the volume of a liquid does not depend on the container it is in.

Section 4.1 Review

Studying Matter

Answers for page 50

Multiple Choice

1. d

2. b

3. d

4. b

5. b

6. a

7. e

8. b

Answers for page 51

Written Answer

9. All matter has mass and occupies space.

10. The student should wear goggles and a lab apron.

11. The state of matter that is represented is the solid state. Particles are densely packed together and are not moving around independently of each other.

12. No. A solution looks the same throughout, so you cannot tell whether it is a mixture or a pure substance simply by looking at it.

13. A chemical method, such as electrolysis, is needed to separate a compound into its elements.

14. *Sample answer*: Oxygen is an element and sodium chloride is a compound.

15. A mechanical mixture of magnetic objects (like steel and iron) and other materials can be separated using a magnet.

16. a. This symbol means to use caution when handling hot objects. **b.** This symbols means that care should be taken when using electrical equipment. **c.** This symbols means care should be taken around open flames. **d.** This symbol means eye goggles should be worn. **e.** This symbol means there is danger of cuts or punctures by sharp objects. **f.** This symbol means that a lab apron should be worn.

Section 4.2 Review

Physical Properties

Answers for page 52

Multiple Choice

1. b

2. d

3. c

4. d

5. b

6. b

7. d

8. e

Answers for page 53

9. d

10. b

11. a

12. d

13. c

14. c

15. e

16. b

Answers for page 54

Written Answer

17. A property is a physical property if it can be observed and measured without changing the identity of the substance.

18. A qualitative physical property does not have a numerical value and a quantitative physical property does.

19. I would expect water-soluble paint to dissolve in water and to be coloured.

20. Answers will vary but should include two of the properties listed in Table 4.3 of the student edition.

21. a. An oven mitt should have low thermal conductivity. **b.** An electrical wire should have high electrical conductivity. **c.** A surfboard should have low density (lower than water, at least). **d.** A hammer should be very hard. **e.** A container for water should not be soluble in water. **f.** An anchor should be very dense.

22. a. The reverse of sublimation is deposition. **b.** The reverse of solidification is melting. **c.** The reverse of condensation is evaporation.

23. Compound A is because a greater amount of it can dissolve in a given volume of water

24. DDT has low solubility in water (so very little is excreted) but high solubility in fat. Therefore, DDT accumulates in the fat deposits of animals.

Answers for page 55

25. The Mohs scale is used as a quantitative measure to describe the hardness of a substance.

26. Oil is not soluble in water and is less dense than water, so it forms large slicks on the surface of water.

27. The density of the metal is 2.7 g/cm^3 (13.5 g ÷ 5.0 cm^3 = 2.7 g/cm^3).

28. The density of the liquid is 0.90 g/cm^3 (45 g ÷ 50 cm^3 = 0.90 g/cm^3).

29. The density of the substance is high.

30. *Sample answer*: Water is liquid at room temperature. Water has a melting point of 0°C. Water has a low viscosity.

31. Water dissolves more substances than any other liquid.

32. Water can absorb a lot of heat with only a small change in temperature.

Section 4.3 Review

Chemical Properties

Answers for page 56

Multiple Choice

1. d

2. d

3. d

4. a

5. b

6. e

7. a

8. b

Answers for page 57

Written Answer

9. You look to see if the substance will react with another substance and create one or more new substances.

10. You can determine that acetic acid is reactive with baking soda, and that baking soda is reactive with acetic acid.

11. Aluminum's reactivity with oxygen makes this happen.

12. The campfire relies on the combustibility of the wood. The ash and smoke that form are different substances than the original wood.

13. You can use a combustible substance as a source of heat and light. However, the reaction could get out of control and become dangerous.

14. The more stable a substance is, the longer it takes to break down.

15. A LD_{50} value is the dose needed to kill 50 percent of the exposed population. A substance with a low LD_{50} value is more toxic than a substance with a greater LD_{50} value.

16. A substance that is very stable does not break down quickly. Therefore, it can build up in the environment and in organisms to higher levels than a less stable substance can. As a result, the more stable substance can have more harmful toxic effects.

Chapter 4 Review

Properties of Elements and Compounds

Answers for page 58

Multiple Choice

1. c

2. e

3. d

4. c

5. d

6. a

7. d

8. b

Answers for page 59

Written Answer

9. Three references to help you stay safe in the laboratory are safety symbols, WHMIS symbols, and material safety data sheets (MSDS).

10. *Sample answer*: An iron nail has a grey colour (physical), can rust (chemical), and can bend without breaking (physical).

11. a. The liquid that is in the bottom layer has the greatest density. In general, liquids that do not dissolve in one another will separate according to density, with the most dense at the bottom and the least dense at the top. **b.** The liquids will mix together and form a single layer. They will not separate back into the original layers after they are mixed.

12. Elements and compounds are both classified as pure substances.

13. a. Apple juice is a mixture. **b.** Gold is an element. **c.** Carbon dioxide is a compound. **d.** Neon is an element.

14. a. The bending of a wire is a physical change. **b.** Copper's ability to bend without breaking is a physical property.

15. The higher the value on the scale, the harder the material is. By comparing the numerical values of two materials, you can easily tell which material is harder.

16. The mass of the nugget is 28.4 g (1.47 $cm^3 \times 19.3$ $g/cm^3 = 28.4$ g).

Answers for page 60

17. Safety goggles and a lab apron should be worn at all times. Caution should be taken around the Bunsen burner, and the student should be careful not to touch the hot glass with bare hands. Thermal gloves should be worn when handling the flask. Long hair should be tied back.

18. A sample of an element, a compound, or a solution looks the same throughout the sample. Elements and compounds are pure substances, so each one is made up of only one type of particle. Although a solution is a mixture and is made up of at least two types of particles, the particles are so small and well mixed together that the solution appears the same throughout.

19. Because they have a numerical value, quantitative properties are easier to compare to reference materials or to the results of others. Qualitative properties can often be described in different ways by different people and therefore are not as easy to compare.

20. The lava has a high viscosity because it flows very slowly.

21. A substance that is reactive with water will form new substances when put into water, but a substance that is soluble in water will not.

22. The teacher is demonstrating a chemical property of the metal because contact between the metal and the liquid forms a new substance—the gas bubbles.

23. Index of refraction is a physical property. Neither the glass nor the water is changed to a different substance as light enters it, so there is no change in identity of the substances.

24. The chemical property of oxygen that is used for this test is combustibility.

Answers for page 61

25. Positive consequences of stopping the use of fertilizers and pesticides include stopping any additional chemical run-off into the soil and into local waterways, and preventing these chemicals from being on the food itself. Negative consequences of stopping the use of these chemicals include a decrease in crop yield due to decreased growth, and increased loss due to pests followed by an increase in the cost of the food in the markets.

26. As the cold dry ice sublimates and becomes a gas, it absorbs energy from the air. The gaseous water vapour in the air condenses into liquid water drops.

27. a. I would simply separate the materials by hand based on their physical appearance. **b.** On the scale of a recycling centre, I might take advantage of the property of magnetism and use a magnet to attract the food cans and separate them from the aluminum cans.

28. a. Solubility is a physical property that is important during the steeping process. **b.** A mechanical mixture is in the teacup during the steeping process. **c.** Filtration is the physical separation method used as the tea bag is removed. **d.** A solution remains in the teacup after the tea bag is removed.

29. Water's ability to dissolve many different things is helpful to an organism because it provides a convenient way to transport the many chemicals and nutrients that the organism needs to the cells in its body. This same ability can be harmful to the organism because toxins can dissolve in water and be carried to these same cells.

30. *Sample answer*: camping stoves that use propane. Warnings can include keeping an open flame away from tanks, using in a properly vented area, and ensuring that the propane tank is in good working order and that there are no leaks.

31. A chemical property of a substance describes the ability of the substance to react with other substances. If no other substances are available, you could not identify a chemical property.

32. Almost all substances can become toxic in high enough concentrations. Thus, although oxygen is necessary for life, it can still be toxic.

Section 5.1 Review

Evolution of the Atomic Model

Answers for page 62

Multiple Choice

1. c

2. b

3. a

4. b

5. d

6. e

7. c

8. d

Answers for page 63

Written Answer

9. He experimented with different gases and liquids, and studied their chemical changes.

10. Joseph John Thomson discovered electrons, which meant that atoms are made up of smaller particles.

11. a. This model first represented the atom as having a nucleus. **b.** Positively charged alpha particles were aimed at a piece of gold foil.

12. Curie discovered and isolated the element radium, which was the source of alpha particles used by Rutherford. Without a sample of this element, Rutherford might not have performed the experiment that resulted in the discovery of the nucleus.

13. Since opposite charges attract each other, scientists wondered why electrons would not be pulled into the nucleus and crash if Rutherford's model were correct. They also wondered why repulsion from the positive charges in the nucleus would not cause it to fly apart.

14. Electrons move within fixed regions or energy levels within an atom.

15. The nucleus is the small, dense, positively charged centre of an atom. It is composed of protons and neutrons.

16. Subatomic particles are particles that are smaller than the atom. Three examples of subatomic particles are protons, electrons, and neutrons.

Section 5.2 Review

The Structure of the Atom

Answers for page 64

Multiple Choice

1. c

2. c

3. e

4. a

5. b

6. b

7. c

8. a

Answers for page 65

9. d

10. d

11. c

12. a

13. a

14. b

15. b

16. e

Answers for page 66

Written Answer

17. Properties of Subatomic Particles

electron	–	energy levels	1

		surrounding the nucleus	
proton	+	nucleus	1836
neutron	0	nucleus	1837

18. The strong force holds neutrons and protons together in the nucleus. It overcomes the repulsive force between protons due to their electric charge.

19. If you know the number of protons in the nucleus of a neutral atom, you also know the number of electrons in that atom.

20. The atomic number is 7.

21. The atom has 4 neutrons.

22. a. The element is manganese. Manganese has an atomic number of 25. **b.** There are 25 protons, 30 neutrons, and 25 electrons in the atom.

23. $^{131}_{53}\mathrm{I}$

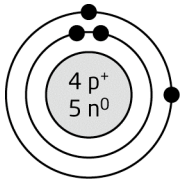
24. a. $^{24}_{12}\mathrm{Mg}$ **b.** $^{20}_{10}\mathrm{Ne}$ **c.** $^{31}_{15}\mathrm{P}$ **d.** $^{14}_{7}\mathrm{N}$ **e.** $^{27}_{13}\mathrm{Al}$ **f.** $^{40}_{18}\mathrm{Ar}$

Answers for page 67

25. Another name for energy levels is shells.

26. Three energy levels are occupied.

27.



28. Isotopes of an element differ in the number of neutrons and in the mass number of each atom.

29. The statement is not true. Because isotopes of an element have different numbers of neutrons, the atoms of sodium cannot have the same number of neutrons.

30. The isotope of carbon represented has 8 neutrons.

31. Hydrogen-1 is the isotope of hydrogen that has a nucleus that is composed of 1 proton and no neutrons. Hydrogen-2 is the isotope of hydrogen that has a nucleus that is composed of 1 proton and 1 neutron.

32. a. Protons and neutrons are made up of smaller subatomic particles. **b.** The particles that make up protons and neutrons are called quarks.

Section 5.3 Review

The Periodic Table

Answers for page 68

Multiple Choice

1. d

2. b

3. b

4. e

5. a

6. b

7. c

8. d

Answers for page 69

Written Answer

9. Mendeleev's table was very helpful in predicting properties of unknown elements based on the properties of known elements.

10. The number in each cell is the atomic number of the element. It represents the number of protons that compose the nucleus of each atom of that element.

11. a. Germanium (Ge) has an atomic number of 32, an atomic mass of 72.6, and is a metalloid. **b.** Iron (Fe) has an atomic number of 26, an atomic mass of 55.8, and is a metal. **c.** Selenium (Se) has an atomic number of 34, an atomic mass of 79.0, and is a non-metal.

12. Mining companies use cyanide solution to dissolve gold in order to separate pieces of gold that are too small to pick out individually from large amounts of rock.

13. Mercury, in the form of methyl mercury, has contaminated waterways of Aboriginal lands.

14. A period is a horizontal row of elements on the periodic table, and a group is a vertical column of elements on the periodic table.

15. A group is called a family because the elements in a group tend to have very similar chemical and physical properties.

16. The halogens in Group 17 are made up of reactive non-metals.

Section 5.4 Review

Trends in the Periodic Table

Answers for page 70

Multiple Choice

1. a

2. e

3. d

4. c

5. d

6. b

7. a

8. c

Answers for page 71

Written Answer

9. a. An atom of boron has 3 valence electrons. **b.** An atom of neon has 8 valence electrons. **c.** An atom of sulfur has 6 valence electrons. **d.** An atom of magnesium has 2 valence electrons.

10. Atoms of these elements are only one electron away from having a full set of valence electrons.

11. a. The number of valence electrons increases as you move from left to right across a period. **b.** The number of valence electrons does not change as you move from top to bottom within a group.

12. The noble gases have atoms that have a full set of valence electrons.

13. The atoms of elements in a group have the same number of valence electrons.

14. The larger an atom is, the farther the valence electrons are from the nucleus and the more easily the electrons can be lost.

15. Lithium atoms are smaller than sodium atoms, which makes it harder for a lithium atom to lose its valence electron.

16. As you move from top to bottom within a group, atoms get larger because electrons occupy more energy levels.

Chapter 5 Review

Understanding the Properties of Elements

Answers for page 72

Multiple Choice

1. d

2. b

3. e

4. a

5. a

6. a

7. e

8. c

Answers for page 73

Written Answer

9. Electrons were discovered through the use of a gas discharge tube.

10. Alpha particles passed through the foil because the nucleus is very small compared with the size of the atom, which means that each atom is mostly empty space.

11. The atomic number and the mass number are whole numbers because they are the sum of the number of certain subatomic particles in an atom. Atomic mass is an average, based on the relative proportion of isotopes present, which often results in a decimal answer.

12. Mendeleev organized elements based on increasing atomic mass. The current table is organized based on increasing atomic number.

13. *Sample answer*: Metals tend to be shiny, malleable, and good electrical conductors.

14. a. An atom of calcium has 2 valence electrons. **b.** An atom of neon has 8 valence electrons.

15. An atom can lose, share, or gain electrons to fill its outer energy level.

16. Group A, with the exception of hydrogen, is the alkali metals. They are very reactive metals, and their atoms have 1 valence electron each. Group B is the alkaline-earth metals. They are very reactive metals, and their atoms have 2 valence electrons each. Group C is the halogens. They are very reactive non-metals, and their atoms have 7 valence electrons each. Group D is the noble gases. They are non-reactive non-metals, and their atoms have 8 valence electrons each, except for helium—it has only 2 valence electrons.

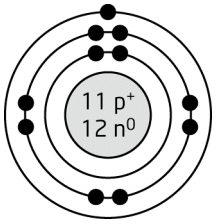
Answers for page 74

17. Rutherford modified Thomson's model, and Bohr modified Rutherford's model. Rutherford was Thomson's student, and Bohr was Rutherford's student.

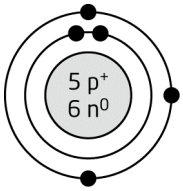
18. *Sample answer*: learning about the atom has allowed scientists to develop numerous kinds of technology. For example, a greater understanding of atoms has resulted in cellphones and computers that are smaller, lighter, and have more features.

19. Answers should include a Bohr-Rutherford diagram of the atom, using symbols to represent the protons and electrons. Also, the chemical symbol of an element could be indicated, since it is internationally recognized.

20. a. The element is sodium. Sodium has an atomic number of 11, which is the number of protons in every atom of sodium. **b.**



21. a. The element is boron. Boron has an atomic number of 5. **b.**



c. Student diagrams should appear similar to the one done in section b, with the only difference being a change in the number of neutrons.

22. Scientists first theorize about what new elements could be synthesized based on where they would be placed in the periodic table, relative to where known elements are. They can then attempt to synthesize those elements by combing certain atoms or nuclei.

23. Based on atomic numbers, there is no missing element that could fall between gold and platinum on the periodic table.

24. Metalloids are located between the metals and the non-metals on the periodic table. Likewise, the properties of metalloids fall between the properties of metals and the properties of non-metals.

Answers for page 75

25. Student answers should reflect that it represents a good alternative because gold mining has environmental and health hazards associated with it.

26. Toxins and metals, such as mercury, can build up to dangerous levels in the fish. Eating the fish would cause the toxins to enter your body and could result in health problems.

27. a. The diagram represents an atom of magnesium. Since this element is a metal, it is hard, shiny, malleable, ductile, and is a good conductor of heat and electricity. **b.** *Sample answer*: An example of a more reactive element is sodium. Sodium is more reactive because it only needs to lose one valence electron to achieve a stable octet. Student answers that have metals below magnesium in the same group should include the explanation that they are more reactive because atoms of these elements lose their electrons more easily.

28. The first energy level is full when it holds 2 electrons. So, the third electron in an atom must enter the second energy level, which then begins the second period.

29. a. Based only on the number of its valence electrons, helium should be in Group 2 because all atoms in Group 2 have 2 valence electrons. **b.** Group 18 is the proper place for helium because it is non-reactive and its atoms have a full outer energy level of electrons. These properties match the properties of noble gases, which are located in Group 18.

30. a. From these diagrams you can determine that atoms get larger as you move down a group. An additional circle is added to the outside of the diagram for the new energy level as you move down a group, so the models also get larger. **b.** The trend across a period cannot be determined from these diagrams. All diagrams across a period are the same size because each atom in a period has the same number of occupied energy levels.

31. Sodium is more reactive than lithium. Its valence electrons are further from the nucleus and, therefore, can be more readily lost.

32. Atoms of elements at the bottom of a group are larger than atoms of elements at the top of the group. The attraction of the nucleus for the valence electrons is weaker in the larger atoms, so the electrons would be easier to share.

Section 6.1 Review

Ionic Compounds

Answers for page 76

Multiple Choice

1. e

2. b

3. d

4. b

5. c

6. b

7. d

8. c

Answers for page 77

9. c

10. e

11. e

12. a

13. c

14. d

15. c

16. d

Answers for page 78

Written Answer

17. An ion is a positively or negatively charged atom or molecule.

18. Atoms of noble gases have full outer energy levels of electrons, which is a highly stable electronic configuration. As a result, they do not readily gain or lose electrons.

19. a. An ionic compound is represented because the charges on the ions are shown. **b.** The particles represented are held together by an ionic bond. Oppositely charged ions are indicated, which have been generated by the transfer of an electron from one of the atoms to the other.

20. The ionic compound is neutral because the total positive charge and total negative charge of the ions are equal and cancel each other.

21. An ionic compound forms when electrons given up by one atom are taken in by another atom. This transfer of electrons cannot happen between atoms of two metals because both atoms tend to give up electrons.

22. The fluoride ions help to strengthen tooth enamel, which is the hard outer layer on teeth.

23. Ionic bonds tend to be very strong and therefore require a large amount of energy to break.

24. a. The ions of an ionic compound in the solid state are arranged in a regular repeating pattern called a crystal lattice. **b.** Each ion in the crystal lattice is surrounded by and strongly attracted to oppositely charged ions. A large amount of energy is needed to overcome these attractions and melt the crystal, so a high temperature is needed.

Answers for page 79

25. Sodium ions and potassium ions are important for transmitting nerve impulses and controlling muscular contractions. Solubility in water is an important property of compounds that are composed of these ions because the ions must be carried to where they are needed by blood and other body fluids, which are aqueous based.

26. Ammonium nitrate provides nitrogen, ammonium phosphate provides phosphorus, and potassium chloride provides potassium.

27. The fertilizer can be dissolved in rainwater or in water used for irrigation and washed into the pond. The added nutrients cause increased growth of algae. After the algae die, micro-organisms that break down the remains use large amounts of oxygen. If the oxygen levels in the pond fall, fish can die.

28. Ionic compounds are good electrical conductors in the liquid state and in aqueous solution. Under these conditions, the charged ions are free to move and can conduct an electric current.

29. Tap water contains dissolved ionic compounds that cause it to have a greater electrical conductivity than pure water.

30. As salt dissolves in water on an icy road, it forms a solution that has a freezing point lower than that of pure water, which helps prevent the water from refreezing. The saltwater solution forms a layer between the road and any snow or ice, which allows vehicles to break up the snow and ice and makes it easier for ploughs to remove the snow and ice from the road.

31. Wind can blow the solid salt from the road. Also, the solid salt can dissolve in water on the road, and the salt water that is formed can drain into ecosystems.

32. When salt dissolves in water, the resulting solution is a better electrical conductor than water alone. Rusting occurs faster as a result of the increased conductivity of the salt solution.

Section 6.2 Review

Molecular Compounds

Answers for page 80

Multiple Choice

1. d

2. b

3. b

4. b

5. e

6. c

7. d

8. c

Answers for page 81

9. c

10. d

11. c

12. b

13. a

14. c

15. b

16. c

Answers for page 82

Written Answer

17. Edible films can perform the same functions as plastic wrap for protecting food, but unlike plastic film, the edible films would help reduce the amount of trash generated.

18. A molecular compound is formed when atoms share electrons in a covalent bond.

19. Electrons in a covalent bond are shared by the atoms joined by the bond.

20. The basis of the force that holds covalently bonded atoms together is the attraction between the positively charged protons in each nucleus to the negatively charged shared electrons.

21. The two teams in a tug-of-war game are joined by their mutual pull on the rope, which is similar to the two atoms being joined by their mutual attraction to the electrons that are shared in a covalent bond.

22. A covalent bond is represented by placing the pair of shared electrons between the atoms that share them so that these electrons are within the outer energy level of each atom.

23. After forming a covalent bond, an atom has a full outer energy level of electrons.

24. An atom that has a full outer energy level of electrons has greater stability than an atom that does not.

Answers for page 83

25. Because they need few electrons to achieve a full outer energy level, non-metal atoms can fill the level by sharing electrons with another non-metal atom. Metal atoms have few valence electrons, so they cannot fill their outer energy level through sharing.

26. a. There are 3 covalent bonds in this molecule. **b.** There are 6 electrons in the bonds and 4 electrons that are not in bonds.

27. A molecule can be composed of just one kind of atom as long as those atoms are joined by a covalent bond. A molecule of oxygen, O_2, is an example of a molecule that is composed of just one kind of atom.

28. One atom of carbon is present in each molecule of carbon dioxide.

29. a. The prefix *mono-* represents 1 atom. **b.** The prefix *penta-* represents 5 atoms. **c.** The prefix *octa-* represents 8 atoms. **d.** The prefix *deca-* represents 10 atoms.

30. The melting and boiling points of a substance are a measure of how strong the forces are between particles of the substance. Molecular compounds tend to have weak forces of attraction between particles, so it does not take much energy to overcome the forces and melt the substance.

31. Carbon dioxide, a molecular compound, gives soft drinks their fizz, but the low solubility of carbon dioxide would cause soft drinks to go flat quickly. Manufacturers pack soft drinks under high pressure to make more carbon dioxide dissolve in the drink.

32. *Sample answer*: Plastics do not easily degrade. Only some plastics can be recycled.

Section 6.3 Review

Modelling Compounds

Answers for page 84

Multiple Choice

1. d

2. a

3. a

4. e

5. c

6. e

7. d

8. a

Answers for page 85

Written Answer

9. The Bohr-Rutherford diagram shows all of the electrons in the atoms, so you can see the number of occupied energy levels.

10. a. This model is a Bohr-Rutherford diagram. **b.** The compound represented is a molecular compound. The outer energy levels overlap and have electrons that appear to belong to more than one atom. In addition, there are no charged particles or square brackets shown that are normally used to represent ionic compounds. **c.** The name of this compound is carbon dioxide.

11. An atom of hydrogen can have at most two electrons in a Bohr-Rutherford diagram because it has one valence electron of its own. When it shares that one electron with another atom, it forms a covalent bond that contains two electrons, which fills the hydrogen atom's outer energy level.

12. The shape of a molecule has a strong influence on the properties of the compound.

13. The balls that represent atoms in model kits often have holes that are at the correct orientation. When using gumdrops, you have to decide at which angles to attach the other atoms in the model, so the model does not show you the proper orientation on its own.

14. A ball-and-stick model is a three-dimensional model. If you draw a picture of it, you lose some of the benefits of the three-dimensional nature of the model.

15. Since a space-filling model must use the correct relative size of atoms, it would be difficult to locate common objects that had the proper dimensions.

16. The relative sizes of atom in a space-filling model allow scientists to learn more about how these molecules interact with chemicals in both helpful and harmful ways.

Chapter 6 Review

Understanding the Properties of Compounds

Answers for page 86

Multiple Choice

1. b

2. b

3. c

4. e

5. d

6. c

7. a

8. d

Answers for page 87

Written Answer

9. a. One electron was gained in the formation of F^-. **b.** Two electrons were lost in the formation of Ba^{2+}.

10. a. A bromine atom needs one electron. **b.** A sulfur atom needs two electrons. **c.** A neon atom needs no electrons.

11. Each bond involves the attraction of particles due to electric charge.

12. a. CsBr is an ionic compound. **b.** CF_4 is a molecular compound.

13. a. Nitrogen dioxide is a molecular compound because its name contains two non-metals and uses the prefix *di-*. **b.** Silver iodide is an ionic compound because its name contains a metal and a non-metal.

14. *Sample answer*: Sodium chloride is an ionic compound, and carbon tetrachloride is a molecular compound.

15. a. Electrons are shared between sulfur atoms and chlorine atoms to form sulfur dichloride. The name indicates that the compound is molecular, so electrons are shared between the atoms. **b.** Electrons are given away by magnesium atoms and taken in by sulfur atoms. The presence of a metal and a non-metal indicates that the compound is ionic, so electrons are transferred from the metal atoms to the non-metal atoms.

16. a. Methane is a molecular compound. **b.** This model is a ball-and-stick model. **c.** This model does not show the electrons around the central atom. A Bohr-Rutherford model could help answer this question.

Answers for page 88

17. The number of electrons lost by metal atoms cannot be greater than the number of electrons gained by non-metal atoms when an ionic compound forms. Metal atoms cannot give away an electron without a non-metal atom that will take it in.

18. An ionic compound forms when electrons lost by one atom are gained by another atom. This transfer of electrons cannot happen between atoms of two non-metals because both atoms tend to gain electrons.

19. Ionic bonds exist in all directions because each ion is attracted to any nearby ion that has the opposite charge. To melt an ionic compound, you must supply enough energy to overcome each ionic bond.

20. a. I would expect calcium chloride to lower the freezing point more than sodium chloride because calcium chloride contains three ions ($CaCl_2$) and sodium chloride contains only two (NaCl). **b.** A compound might not be used because it is too expensive or because it might have more harmful effects on the environment.

21. There is a concern about how to determine the best level of exposure to fluoride. Because fluoride is available from a variety of sources, including toothpaste, drinking water, and drinks that are made using fluoridated water, some scientists worry that people might be getting too much fluoride, which might lead to problems such as discoloured teeth, cancer, and fragile bones.

22. Consequences of Fertilizer Use

Advantages	Disadvantages
increase crop yields	can contaminate local water sources
reduced labour costs	can affect local ecosystems
reduced cost of produce	

23. A chemical bond holds two atoms together. If the chemical bond is formed as a result of the transfer of electrons between the atoms, the bond is an ionic bond. If the chemical bond is formed as a result of the sharing of electrons between the atoms, the bond is a covalent bond.

24. Substance A is an ionic compound because all three observations match the properties common to most ionic compounds. Substance B is a molecular compound. Although the appearance and solubility of substance B match the properties of an ionic compound, the lack of conductivity of the solution indicates that there are no ions present in the solution, so the substance is likely to be molecular. Substance C is a molecular compound because all three properties match the properties that are common to many molecular compounds.

Answers for page 89

25. The names of the compounds tell you that both are composed of the elements carbon and oxygen and that there is one carbon atom in a molecule of each compound. The names also tell you that a carbon dioxide molecule is composed of two oxygen atoms and a carbon monoxide molecule is composed of one oxygen atom.

26. Nitrogen monoxide is a molecular compound, so it should have a lower melting point than aluminum chloride, which is an ionic compound.

27. A good electrical conductor must have charged particles that move freely. Although the molecules of a liquid move freely past one another, the molecules are not charged and therefore cannot conduct an electric current.

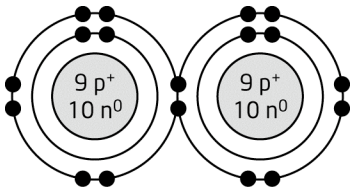
28. Molecular compounds would likely have stronger odours than ionic compounds have. The forces of attraction between molecules are weaker than the ionic bonds between ions, so it is easier for molecules of molecular compounds to become a gas that you can smell.

29. Water should be classified as a molecular compound because it is composed of two non-metals whose atoms share electrons. Although ice is a crystalline solid, it melts at room temperature, so the melting point of water is not as high as that of most ionic compounds.

30. a. Two molecular compounds that are in the bottle are water and carbon dioxide (in the bubbles). **b.** The bubbles are carbon dioxide gas coming out of solution, which is due to a decrease in pressure in the bottle when the cap is loosened.

31. Stitches that are soluble will dissolve over time as the wound heals. Additional surgery is not needed to remove the stitches, which prevents additional medical costs and the possibility of infection or complications that could result from the additional surgery. In addition, the recovery time is reduced, so the patient can return to his or her regular routine sooner.

32.



Atoms, Elements, and Compounds

Answers for page 90

1. a. To determine the density of a liquid, a balance to determine the liquid's mass and a graduated cylinder to determine the liquid's volume could be used. Then the mass divided by the volume can be calculated to determine the density of the liquid. **b.** Safety goggles, lab apron, and gloves should be worn during the investigation. Since the liquid is corrosive, the student should avoid all skin contact with the liquid and notify the teacher of any spills. If any liquid is spilled on skin, the area should be rinsed with water immediately.

2. Tungsten has a high melting point, which keeps the filament from melting, and high electrical conductivity, which allows it to conduct an electric current.

3. The substance is toxic because it was poisonous and led to the victim's death. It must also be stable, since it built up in the victim over time without breaking down.

4. Steel provides greater structural strength than aluminum does. Although the use of aluminum could reduce damage to cars due to rust and could also result in greater fuel economy because of lighter cars, the benefits are outweighed by the increased risk of injury during an accident.

5. Effects of Propane Use

Negative Effects	Positive Effects
Combustibility can lead to fires	Provides energy used for heating
Potential for explosions	Provides energy used for cooking
	Provides jobs for people in the industries that manufacture and transport it

6. Natural gas is odourless, so without an added scent a leak would be hard to detect. The *t*-butyl mercaptan has a very strong and alarming odour that is easy to detect. Adding *t*-butyl mercaptan to natural gas provides a quick and easy way to detect even small gas leaks before the gas can build to dangerous levels.

7. a. I would describe the tablet as having the chemical property of reactivity with water, because a new substance in the form of gas bubbles was made when the tablet was placed into water. **b.** This tells me that the sodium bicarbonate in the tablet is not reacting with the water. **c.** The ingredients in the tablet dissolve in water and once dissolved, these ingredients react with each other (instead of with the water) to form the gas. **d.** Sodium bicarbonate is an ionic compound.

8. a. The element described is magnesium. **b.** The element described is oxygen. **c.** The element described is krypton. **d.** The element described is lithium.

Answers for page 91

9. Illustrations should include the following key points: Metal atoms tend to lose their valence electrons when they react. As you move down a group, atomic size increases and the atoms lose electrons more easily. Therefore, metals become more reactive as you move down a group.

10. *Sample answer*: Atomic size increases going down the periodic table and across, from right to left. Determine where the atoms are positioned, relative to each other, in the periodic table. The atom that is nearest the top and to the right-hand side of the table is the smallest. Identify each atom, moving left and down the periodic table until the atom furthest to the left and lowest in the periodic table is identified, which is the largest atom. The correct order by increasing atomic size is argon, sulfur, aluminum, and indium. Argon is furthest to the right-hand side of the periodic table and, therefore, the smallest. Sulfur is to the left of argon, and aluminum to the left of sulfur. Indium is in the same group as aluminum, but since it is lower on the periodic table it is larger than aluminum and the largest of the series of atoms.

11. The outermost occupied energy level for both ions is the third energy level. A calcium ion forms when a calcium atom loses 2 electrons from the fourth energy level, which leaves 18 electrons in the ion. A sulfide ion forms when a sulfur atom gains 2 electrons to complete the third energy level and has a total of 18 electrons.

12. Pure water is a molecular compound and is a poor electrical conductor. But the water purified by this product is a good electrical conductor, as indicated by the lit bulb of the conductivity tester. To conduct an electric current so well, the water must contain dissolved ionic compounds, and is therefore not pure.

13. *Sample answer*: I would expect to see molecular compounds. Ionic compounds are held together by very strong ionic bonds, so they tend to be odourless. Molecular compounds have weaker forces between molecules, so they are more likely to produce an odour.

14. a. The model shown is a Bohr-Rutherford model. **b.** The central atom is carbon, a non-metal, because it has 6 protons. The other atoms are fluorine, a non-metal, because each atom has 9 protons. **c.** The four outer atoms are not isotopes of one another. Each atom has the same number of neutrons, so they are atoms of a single isotope of the element. **d.** The model shows atoms that share electrons in covalent bonds to make a molecular compound. **e.** This compound is named carbon tetrafluoride.

15. The molecules of carbon monoxide (CO) and oxygen (O_2) are nearly the same size and shape. They each have only two atoms bonded together. This allows the CO molecule to fit into the same binding site that O_2 fits in.

16. Answers will vary: students should choose one issue or product that was discussed in the unit. In addition to the chemical basis for the development, a rationale for why it is an important contribution should also be included.

Answers for page 92

Literacy Test Prep

Diamonds

Multiple Choice

17. b

18. a

19. c

20. d

21. d

Written Answer

22. *Sample answer*: The high lustre of diamond makes it useful as gemstones in jewellery, while the hardness of diamond makes it useful for drilling in industry.

Answers for page 93

Literacy Test Prep

Mercury

Multiple Choice

23. b

24. c

25. a

26. c

27. d

Written Answer

28. Researchers would look for problems in the brains and nervous systems of people who received the vaccine. Finding that certain problems are more common in people who took the vaccine than in people who did not would support the concerns.