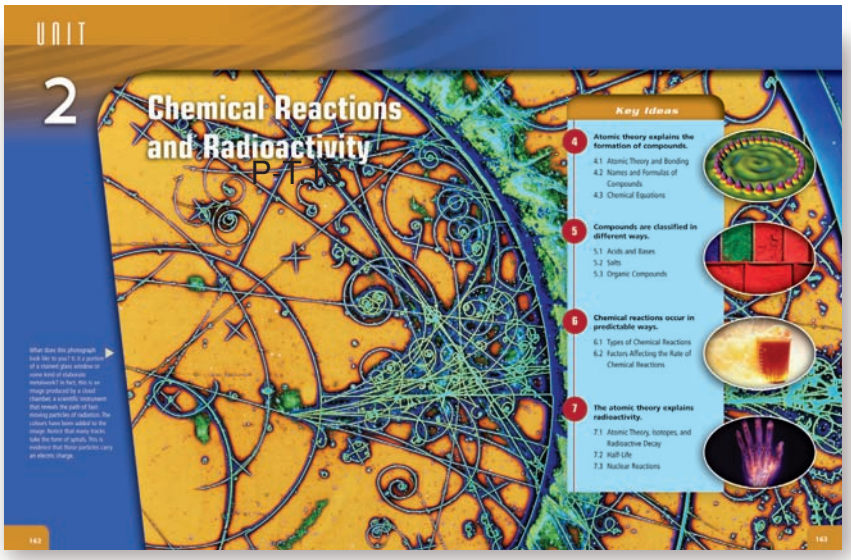
A Tour of Your Textbook

Welcome to ***BC Science 10***. This textbook introduces you to the wonders of ecosystems, chemistry, motion, and heat in the environment. Take a brief tour of your textbook on the following pages. Then do the Scavenger Hunt on page xxi.

Unit Opener

- ***BC Science 10*** has four major units: Sustaining Earth's Ecosystems, Chemical Reactions and Radioactivity, Motion, and Energy Transfer in Natural Systems.
- Each unit opener photo is a window into the world of the Key Ideas you will study in the units. The caption explains the photo.
- The unit opener identifies each of the unit's Key Ideas. These are the chapter titles.
- The small photos next to the Key Ideas are from the beginning of each chapter.

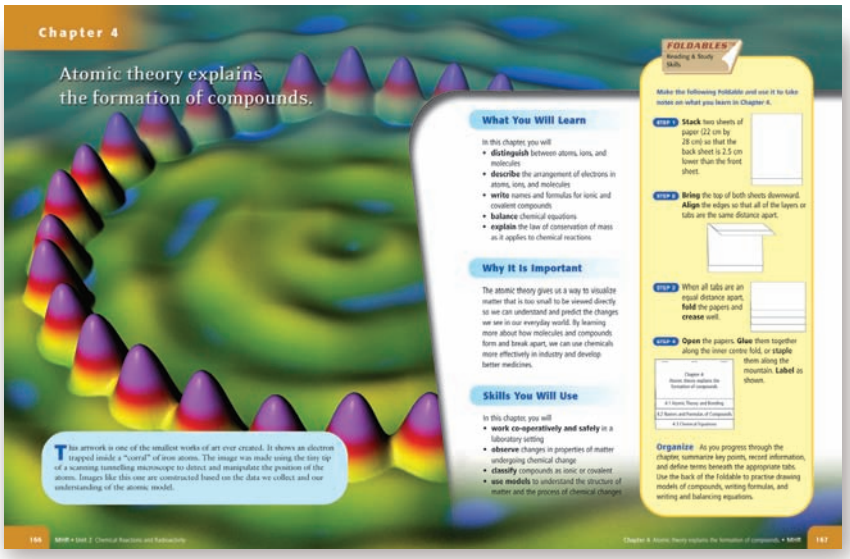


Getting Started

- Getting Started helps you recall what you already know about the Key Ideas in the unit.
- Getting Started helps you prepare for studying the unit by giving you the following:
  - — a short reading about an interesting topic related to the unit
  - — an **Internet Connect** feature to take you to **www.bcscience10.ca** to learn more about the topic
  - — a short **Find Out Activity** so you can explore an idea related to the unit

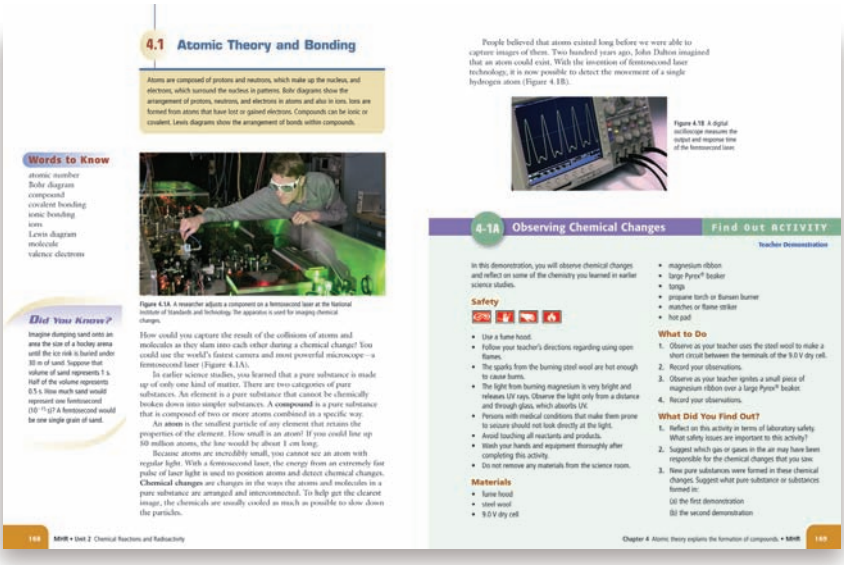
Chapter Opener

- The chapter title sentence is the Key Idea that you will study in this chapter.
- The chapter opener outlines What You Will Learn, Why It Is Important, and Skills You Will Use in the chapter.
- The **Foldables** exercise is a fun way to develop your study skills. Look for a Foldables exercise at the beginning of every chapter.



Section Opener

- Each new section in a chapter begins with a new number and a short title.
- The shaded light brown box below the section title contains a summary of the science concepts you will study in the section.
- The list of Words to Know in the margin identifies important new science terms that you will learn in the section.
- The **Did You Know?** margin feature is an interesting bit of information related to the section's topic.
- Each section opener includes a **Find Out Activity** or a **Think About It**.



Find Out Activity

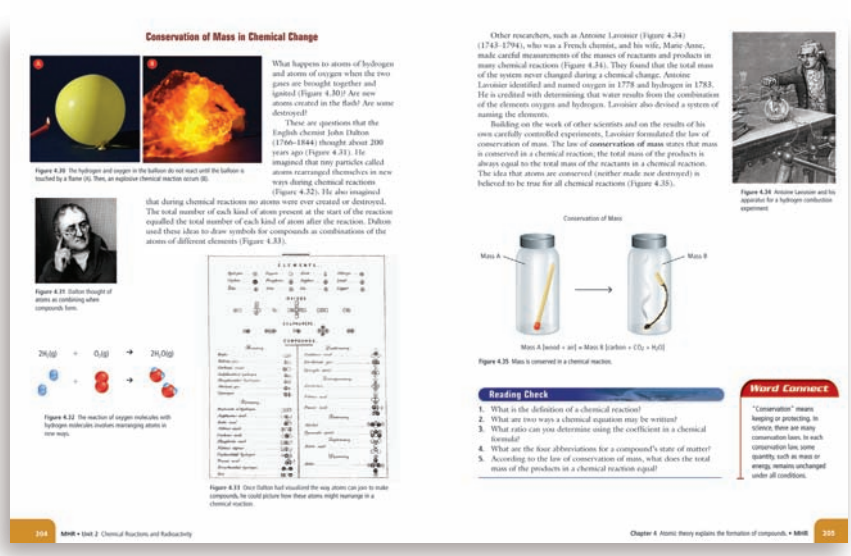
- This short, informal inquiry activity involves hands-on exploration, using simple materials and equipment.
- In these activities and in the investigations, you will use important science process skills, such as predicting, estimating, and hypothesizing.

Science Skills

- This box directs you to one of 13 Science Skills sections at the back of your textbook. The Science Skills sections can help you with graphing, writing an hypothesis, using a microscope, and other skills.

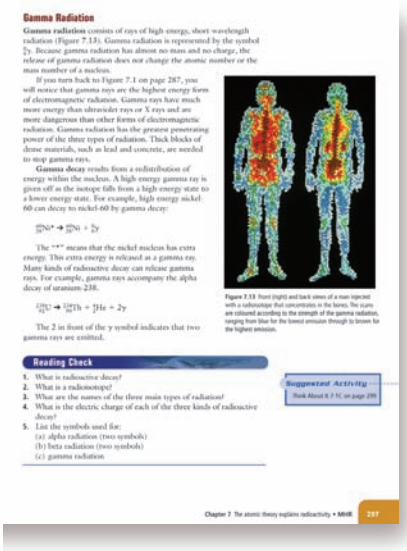
Think About It

- The Think About It activities look similar to Find Out activities, but you do them at your desk. They do not require any special equipment.
- For these activities, you think about a particular idea related to the concepts you are studying in the section.
- You work on your own, with a partner, or in a group, and share your thoughts with your group or class.



Section Text and Activities

- The text of each section is divided into "chunks" to help you understand the content. Each chunk has a title.
- Each picture has a caption that explains what the picture is about.
- Terms you need to know are boldfaced in the text. Each boldfaced term is defined in the text and in the **Glossary** at the back of the textbook.
- **Reading Checks** contain questions that help you test your understanding of what you have just read.
- Find Out and Think About It activities may appear throughout the text. Longer, more formal investigations are at the end of the section.

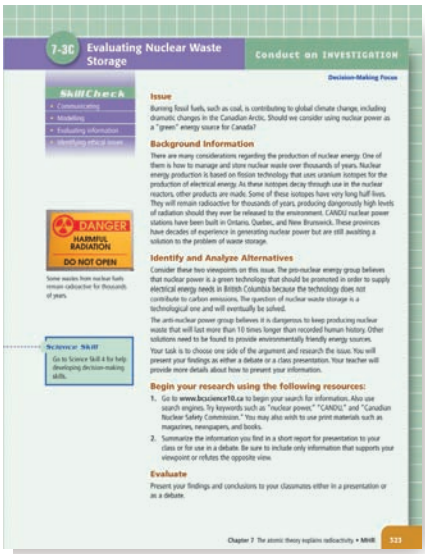


Suggested Activity

- These small margin features indicate related activities your teacher may have you do from the end of the section.

Conduct an Investigation

- These formal labs give you the opportunity to develop science skills using various equipment and materials.
- In these investigations, you can ask questions about science, make observations, and obtain results.
- You then analyze your results to determine what they tell you about the topic you are investigating.
- Photographs help you do the investigation.
- Safety icons and safety warnings alert you to any special precautions you should take to help maintain a safe classroom environment.
- Each investigation has one of the following focuses: inquiry, decision-making, or problem-solving.
- You will also have opportunities to design your own investigation.


7-3C Evaluating Nuclear Waste Storage

Conduct an Investigation

Decision-Making Focus

Skill Check

- Communicating
- Modelling
- Evaluating information
- Identifying ethical issues

Issue

Burning fossil fuels, such as coal, is contributing to global climate change, including dramatic changes in the Canadian Arctic. Should we consider using nuclear power as a "green" energy source for Canada?

Background Information

There are many considerations regarding the production of nuclear energy. One of them is how to manage and store nuclear waste over thousands of years. Nuclear energy production is based on fission technology that uses uranium isotopes for the production of electrical energy. As these isotopes decay through use in the nuclear reactors, other products are made. Some of these isotopes have very long half lives. They will remain radioactive for thousands of years, producing dangerously high levels of radiation should they ever be released to the environment. CANDU nuclear power stations have been built in Ontario, Quebec, and New Brunswick. These provinces have decades of experience in generating nuclear power but are still awaiting a solution to the problem of waste storage.

DANGER HARMFUL RADIATION DO NOT OPEN

Some wastes from nuclear fuels remain radioactive for thousands of years.

Identify and Analyze Alternatives

Consider these two viewpoints on this issue. The pro-nuclear energy group believes that nuclear power is a green technology that should be promoted in order to supply electrical energy needs in British Columbia because the technology does not contribute to carbon emissions. The question of nuclear waste storage is a technological one and will eventually be solved.

The anti-nuclear power group believes it is dangerous to keep producing nuclear waste that will last more than 10 times longer than recorded human history. Other solutions need to be found to provide environmentally friendly energy sources.

Science Skill

Go to Science Skill 4 for help developing decision-making skills.

Your task is to choose one side of the argument and research the issue. You will present your findings as either a debate or a class presentation. Your teacher will provide more details about how to present your information.

Begin your research using the following resources:

1. Go to www.bcscience10.ca to begin your search for information. Also use search engines. Try keywords such as "nuclear power," "CANDU," and "Canadian Nuclear Safety Commission." You may also wish to use print materials such as magazines, newspapers, and books.
2. Summarize the information you find in a short report for presentation to your class or for use in a debate. Be sure to include only information that supports your viewpoint or refutes the opposite view.

Evaluate

Present your findings and conclusions to your classmates either in a presentation or as a debate.

Chapter 7 The atomic theory explains radioactivity • MHR 323

End-of-Section Features

- These features give you an opportunity to learn about applications or explorations of the topic you have studied in the section.
- **Science Watch** features provide information on past and current scientific topics and research.
- The "www" in "**www science**" stands for "wild, weird, wonderful." These features describe interesting and unusual science.
- **National Geographic Visualizing Science** features are exciting visual representations of a science topic.
- **Science-Math Connect** features connect the science you learned in the section to math concepts.
- **Career Connect** features are interviews with people who have a career related to the unit.


Science Watch

Pursuing the Dream of Fusion Power

Plasma rises from active areas on the Sun's surface and follows the path of powerful magnetic fields.

In a fusion power reactor, a magnetic field traps hydrogen plasma. One reactor design uses an electromagnet positioned in the shape of a doughnut. The hot plasma stays inside the doughnut and away from the magnets used to generate the magnetic field. Currently, a number of existing experimental facilities are using this technology.

A technician performs maintenance on the doughnut-shaped device that confines hot plasma.

Nuclear fusion reactions that occur in our Sun produce huge amounts of energy. Is there any way to harness nuclear fusion reactions here on Earth to produce electricity? No commercial nuclear fusion power plants currently exist, but some researchers hope that technologies can be invented to bring fusion power into production in an environmentally friendly way. Many governments have the same hope and have invested billions of dollars in pursuit of this dream.

The centre of our Sun is very hot—about 15 million degrees Celsius. For many decades, researchers have looked for a practical way to recreate the conditions at the centre of our Sun. They have produced extremely hot temperatures during nuclear explosions, but this is not a practical way of producing electricity. An added challenge is that no container made of matter can contain gases that are as hot as the centre of our Sun. Any type of container would melt long before reaching those temperatures. However, there is another way to contain hot gases—with a strong magnetic field.

How can you use a magnetic field to hold gases? Hot gases lose electrons, turning all the atoms into ions. An ionized gas is called plasma.

Given these tremendous challenges as well as huge development costs, why even bother to try to build a fusion power facility? If it could be made to work, fusion power is expected to have a number of advantages. The materials needed for fusion—isotopes of hydrogen—are as plentiful as the oceans themselves. Also, the products of nuclear fusion are expected to be stable isotopes, meaning that there might be no radioactive wastes to worry about. Finally, a small amount of fusion produces a tremendous amount of energy.

Questions

1. What conditions are necessary before isotopes of hydrogen can combine in a fusion reaction?
2. How is the hot plasma trapped so that it can be millions of degrees yet not melt its container?
3. List three possible advantages of a successful fusion power reactor.

324 MHR • Unit 2 Chemical Reactions and Radioactivity


Check Your Understanding

Checking Concepts

1. Most commercial trucks use diesel fuel. Consider the following reaction that occurs during the combustion of diesel fuel.
heptane + oxygen → carbon dioxide + water
$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$
(a) List the names of the reactants.
(b) Give the formulas of the products.
(c) What is the coefficient of the carbon dioxide?
(d) What is the meaning of the + symbol on the left side of the equation?
2. Study the following diagram, and then write a skeleton equation for the reaction it represents. A white circle represents an H atom. A blue circle represents an N atom.

Understanding Key Ideas

3. Copy and balance the following skeleton equations.
(a) $Al + I_2 \rightarrow AlI_3$
(b) $PbCl_4 + K_3PO_4 \rightarrow KCl + Pb_3(PO_4)_4$
(c) $Br_2 + FeI_3 \rightarrow I_2 + FeBr_3$
(d) $Na_2CO_3 + Ce(NO_3)_3 \rightarrow NaNO_3 + Ce_2(CO_3)_3$
(e) $Mn + I_2 \rightarrow MnI_4$
(f) $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$
(g) $K_2SO_4 + AgNO_3 \rightarrow Ag_2SO_4 + KNO_3$
(h) $Ca(OH)_2 + HCl \rightarrow CaCl_2 + H_2O$
(i) $Mg_3N_2 + Mg + N_2$
(j) $Fe + CuCl_2 \rightarrow FeCl_2 + Cu$

4. Write skeleton equations for the following chemical reactions and then balance them. Be sure to check your formulas carefully before you begin to balance.
(a) lithium phosphate + magnesium sulphate → lithium sulphate + magnesium phosphate
(b) zinc iodide + copper(I) nitrate → zinc nitrate + copper(I) iodide
(c) mercury(II) nitrate + sodium hydrogen carbonate → sodium nitrate + mercury(II) hydrogen carbonate
(d) nickel(III) iodide and iron(II) sulphide → nickel(III) sulphide + iron(II) iodide
(e) aluminum hydroxide + hydrogen fluoride → aluminum fluoride + water
(f) hydrogen chloride + barium hydroxide → barium chloride + water
(g) calcium bromide + potassium carbonate → calcium carbonate + potassium bromide
(h) titanium(III) fluoride + cesium sulphite → cesium fluoride + titanium(III) sulphite
(i) barium sulphate + sodium hydroxide → sodium sulphate + barium hydroxide
(j) calcium chloride + potassium → potassium chloride + calcium
(k) hydrogen nitrate + strontium carbonate → strontium nitrate + water + carbon dioxide

Pause and Reflect

The law of conservation of mass was developed after many experiments consistently showed that mass is neither gained nor lost during a chemical reaction. How does our understanding of atoms help explain why mass does not change during chemical reactions?

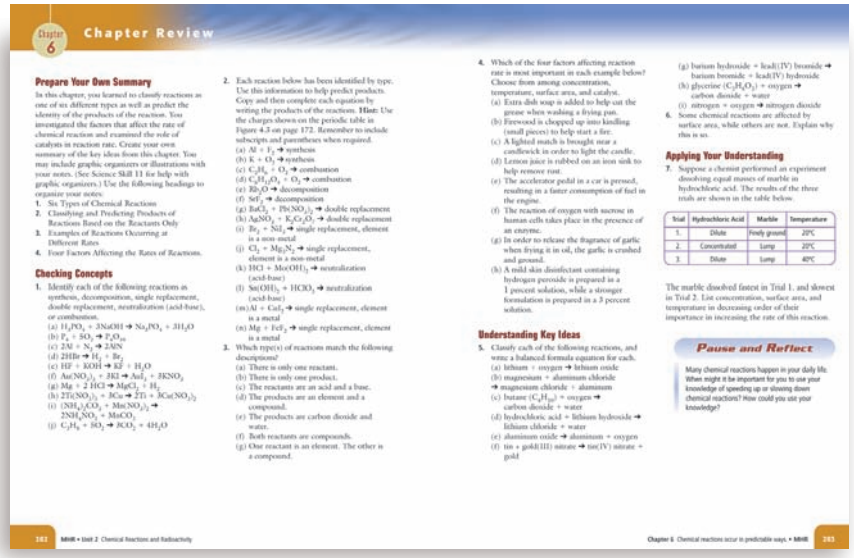
Chapter 4 Atomic theory explains the formation of compounds • MHR 215

Check Your Understanding

- These section review questions test your new knowledge.

Pause and Reflect

- Pause and Reflect features help you stop and think about what you now know about the topics explained in the chapter. They also make connections among ideas throughout your book.

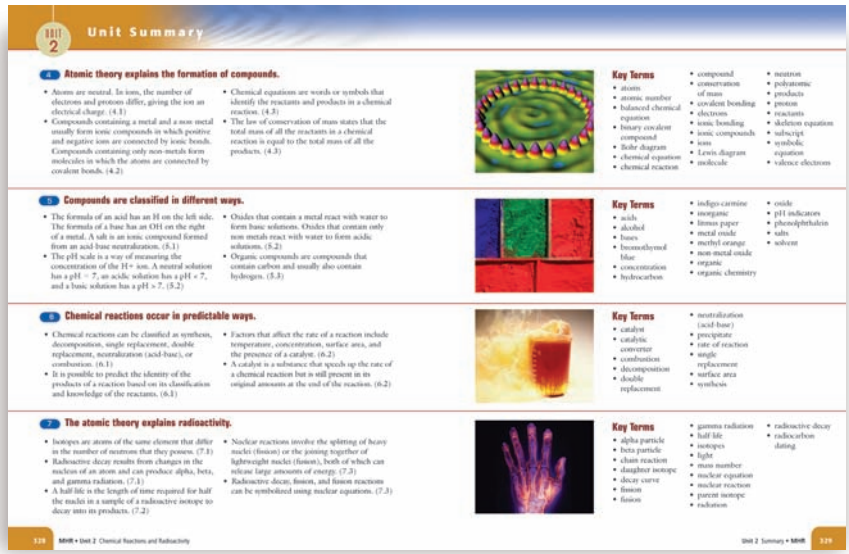


Chapter Review

- At the end of each chapter, the Chapter Review can help you study for a chapter test.
- The guide under the heading "Prepare Your Own Summary" can help you summarize what you have learned in the chapter.
- The review questions help you recall, think about, and apply what you have learned.

Unit Summary

- This is a summary of the Key Ideas and Key Terms covered in the unit.
- The photographs next to the Key Terms are from the chapter openers to remind you of what you covered in that chapter.

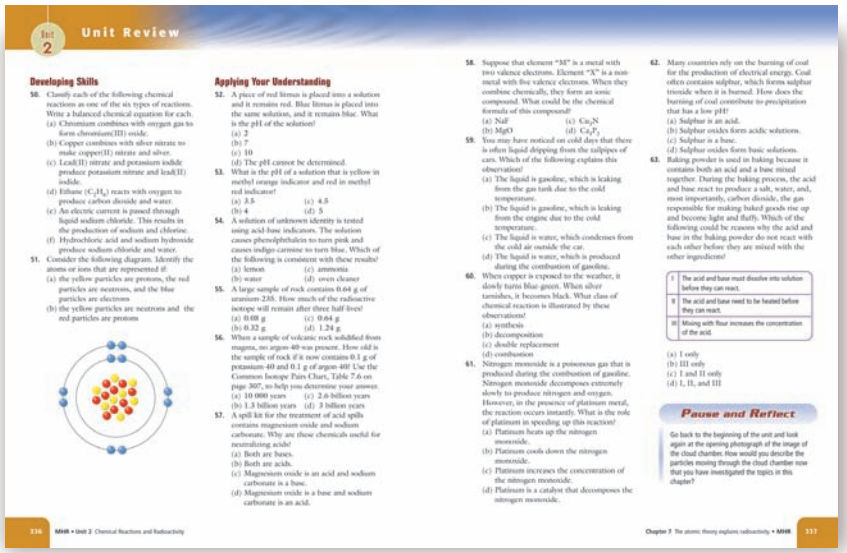


End-of-Unit Project and Integrated Research Investigation

- Each Project lets you apply key concepts and skills from the unit. You complete the Project as part of a team.
- For the Integrated Research Investigation, you explore a unit-related topic. You have an opportunity to use information that you have researched to do a report or presentation about that topic.

Unit Review

- At the end of each unit, the Unit Review can help you study for a unit test.
- The review questions help you recall, think about, and apply what you have learned.


Unit 2 Unit Review

Developing Skills

50. Classify each of the following chemical reactions as one of the six types of reactions. Write a balanced chemical equation for each.
(a) Chromium combines with oxygen gas to form chromium(III) oxide.
(b) Copper combines with silver nitrate to make copper(II) nitrate and silver.
(c) Lead(II) nitrate and potassium iodide produce potassium nitrate and lead(II) iodide.
(d) Ethane (C_2H_6) reacts with oxygen to produce carbon dioxide and water.
(e) An electric current is passed through liquid sodium chloride. This results in the production of sodium and chlorine.
(f) Hydrochloric acid and sodium hydroxide produce sodium chloride and water.

51. Consider the following diagram. Identify the atoms or ions that are represented if:
(a) the yellow particles are protons, the red particles are neutrons, and the blue particles are electrons
(b) the yellow particles are neutrons and the red particles are protons

Applying Your Understanding

52. A piece of red litmus is placed into a solution and it remains red. Blue litmus is placed into the same solution, and it remains blue. What is the pH of the solution?
(a) 2
(b) 7
(c) 10
(d) The pH cannot be determined.

53. What is the pH of a solution that is yellow in methyl orange indicator and red in methyl red indicator?
(a) 3.5 (c) 4.5
(b) 4 (d) 5

54. A solution of unknown identity is tested using acid-base indicators. The solution causes phenolphthalein to turn pink and causes indigo carmine to turn blue. Which of the following is consistent with these results?
(a) lemon (c) ammonia
(b) water (d) oven cleaner

55. A large sample of rock contains 0.64 g of uranium-235. How much of the radioactive isotope will remain after three half lives?
(a) 0.08 g (c) 0.64 g
(b) 0.32 g (d) 1.24 g

56. When a sample of volcanic rock solidified from magma, no argon-40 was present. How old is the sample of rock if it now contains 0.1 g of potassium-40 and 0.1 g of argon-40? Use the Common Isotope Pairs Chart, Table 7.6 on page 307, to help you determine your answer.
(a) 10 000 years (c) 2.6 billion years
(b) 1.3 billion years (d) 3 billion years

57. A spill kit for the treatment of acid spills contains magnesium oxide and sodium carbonate. Why are these chemicals useful for neutralizing acids?
(a) Both are bases.
(b) Both are acids.
(c) Magnesium oxide is an acid and sodium carbonate is a base.
(d) Magnesium oxide is a base and sodium carbonate is an acid.

58. Suppose that element "M" is a metal with two valence electrons. Element "X" is a non-metal with five valence electrons. When they combine chemically, they form an ionic compound. What could be the chemical formula of this compound?
(a) NaF (c) Ca_3N
(b) MgO (d) Ca_3P_2

59. You may have noticed on cold days that there is often liquid dripping from the tailpipes of cars. Which of the following explains this observation?
(a) The liquid is gasoline, which is leaking from the gas tank due to the cold temperature.
(b) The liquid is gasoline, which is leaking from the engine due to the cold temperature.
(c) The liquid is water, which condenses from the cold air outside the car.
(d) The liquid is water, which is produced during the combustion of gasoline.

60. When copper is exposed to the weather, it slowly turns blue-green. When silver tarnishes, it becomes black. What class of chemical reaction is illustrated by these observations?
(a) synthesis
(b) decomposition
(c) double replacement
(d) combustion

61. Nitrogen monoxide is a poisonous gas that is produced during the combustion of gasoline. Nitrogen monoxide decomposes extremely slowly to produce nitrogen and oxygen. However, in the presence of platinum metal, the reaction occurs instantly. What is the role of platinum in speeding up this reaction?
(a) Platinum heats up the nitrogen monoxide.
(b) Platinum cools down the nitrogen monoxide.
(c) Platinum increases the concentration of the nitrogen monoxide.
(d) Platinum is a catalyst that decomposes the nitrogen monoxide.

62. Many countries rely on the burning of coal for the production of electrical energy. Coal often contains sulphur, which forms sulphur trioxide when it is burned. How does the burning of coal contribute to precipitation that has a low pH?
(a) Sulphur is an acid.
(b) Sulphur oxides form acidic solutions.
(c) Sulphur is a base.
(d) Sulphur oxides form basic solutions.

63. Baking powder is used in baking because it contains both an acid and a base mixed together. During the baking process, the acid and base react to produce a salt, water, and, most importantly, carbon dioxide, the gas responsible for making baked goods rise up and become light and fluffy. Which of the following could be reasons why the acid and base in the baking powder do not react with each other before they are mixed with the other ingredients?

I	The acid and base must dissolve into solution before they can react.
II	The acid and base need to be heated before they can react.
III	Mixing with flour increases the concentration of the acid.

(a) I only
(b) III only
(c) I and II only
(d) I, II, and III

Pause and Reflect

Go back to the beginning of the unit and look again at the opening photograph of the image of the cloud chamber. How would you describe the particles moving through the cloud chamber now that you have investigated the topics in this chapter?

Other Features

Word Connect

- The Word Connect margin feature gives you additional information on scientific terms.

Explore More

- You can "Explore More" by following the suggestions in these features to investigate further a topic you have studied.

internet connect

- These features help you research more information about a topic.
- The ***BC Science 10*** website links you to other websites related to the topic you are researching.

- Safety icons are included in many activities and investigations. The safety icons are extremely important. They alert you to any safety precautions you should take. Safety icons used in ***BC Science 10*** are shown on page 552.

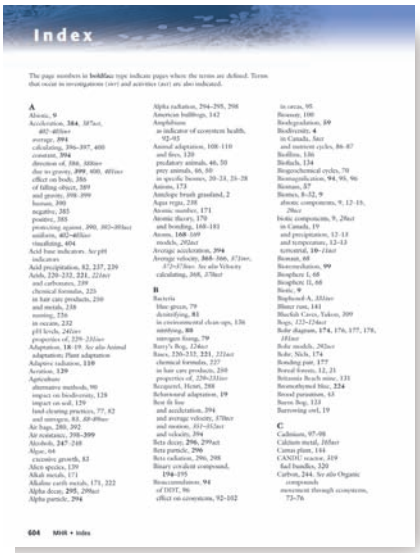
At the Back of Your Textbook

Science Skills

- At the back of ***BC Science 10***, you will find the Science Skills appendix. These guides will help you review and develop the skills and knowledge that you need to be successful in this course.

Glossary

- Each boldfaced term in your textbook is defined in the Glossary at the back of the book.
- The Glossary is organized alphabetically.



Index

- The Index at the back of the book helps you locate a particular topic in the book.
- The Index is organized alphabetically.