

SECTION	STUDENT ACTIVITIES/FEATURES	TEACHER'S RESOURCE PACKAGE
24.1 The s-Block Elements: Active Metals Objectives <ul style="list-style-type: none"> ► List sources, properties, and uses for the alkali metals (Group 1A) and their compounds ► Describe the preparation and properties of the alkaline-earth metals (Group 2A) and give uses for their compounds 	Discover It! <i>Tempering of Metals</i> , p. 704 CHEMath <i>Classification</i> , p. 707 Small-Scale Lab <i>Complex Ions</i> , p. 711	Review Module (Chapters 21–24) <ul style="list-style-type: none"> ► Section Review 24.1 ► Quizzes Laboratory Recordsheet 24-1
24.2 The p-Block Elements: Metals and NonMetals Objectives <ul style="list-style-type: none"> ► Describe properties and uses of <i>p</i>-block metals and nonmetals ► Explain methods for obtaining specific <i>p</i>-block metals and nonmetals from their compounds and minerals 	Link to Oceanography <i>Deep-Sea Minerals</i> , p. 720	Review Module <ul style="list-style-type: none"> ► Section Review 24.2 ► Quizzes Laboratory Manual , Experiment 48: <i>Allotropic Forms of Sulfur</i> Small-Scale Chemistry Lab Manual , Experiment 34: <i>Titration of Bleach</i>
24.3 The d- and f-Block Elements: Transition and Inner Transition Metals Objectives <ul style="list-style-type: none"> ► List the properties of specific transition metals ► Describe the chemical diversity shown by the transition metals and inner transition metals 		Review Module <ul style="list-style-type: none"> ► Section Review 24.3 ► Quizzes Laboratory Manual , Experiment 47: <i>Reactivity of Metals</i> Laboratory Practical 24-1 Small-Scale Chemistry Lab Manual , Experiment 35: <i>Formation of Complex Ions with Ammonia</i>
24.4 Hydrogen and Noble Gases Objectives <ul style="list-style-type: none"> ► Show how hydrogen is unique among the elements ► Explain why the noble gases, Group 0, are important even though they are chemically unreactive 	Link to Environmental Awareness <i>Radon Gas</i> , p. 734 Mini Lab <i>Decomposition of Hydrogen Peroxide</i> , p. 735 Chemistry Serving . . . Industry <i>Diamonds are an Engineer's Best Friend</i> , p. 736 Chemistry in Careers <i>Gemologist</i> , p. 736	Review Module <ul style="list-style-type: none"> ► Section Review 24.4 ► Vocabulary Review 24 ► Interpreting Graphics ► Chapter 24 Tests and Quizzes Laboratory Recordsheet 24-2 Solutions Manual for Chapter Reviews Graphing Calculator Problems

PLANNING GUIDE continued

TECHNOLOGY RESOURCES



Internet Connections

Within this chapter, you will see the chemSURF logo. If you and your students have access to the Internet, the following URL address will provide various Internet connections that are related to topics and features presented in this chapter.

<http://www.chemsurf.com>



You can also find relevant chapter material at The Chemistry Place address:
<http://www.chemplace.com>

CD-ROMs



Chem ASAP! CD-ROM

- ▶ Chapter 24

ResourcePro CD-ROM

- ▶ Chapter 24

Assessment Resources CD-ROM

Videodiscs and Videotapes



Chemistry Alive! Videodisc

- ▶ Making Sodium Chloride
- ▶ Watermelon Surprise
- ▶ Elephant Toothpaste
- ▶ Burning Magnesium
- ▶ Chemtoid: Magnesium Fire During Falkland Islands
- ▶ Thermite Reaction
- ▶ Silicon Alien
- ▶ Oxidation States of Vanadium

ASSESSMENT

Student Edition

- ▶ Section Reviews 24.1–24.4
- ▶ Chapter 24 Review, pp. 737–740
- ▶ Alternative Assessment, p. 741

Technology

Chem ASAP! CD-ROM

- ▶ Assessment 24.1–24.4

Assessment Resources CD-ROM

- ▶ Chapter 24 Tests

Teacher's Resource Package

Review Module (Chap. 21–24)

- ▶ Vocabulary Review
- ▶ Chapter 24 Test A and Test B
- ▶ Chapter 24 Quizzes

PLANNING FOR ACTIVITIES

STUDENT EDITION

Discover It! p. 704

- ▶ hairpins
- ▶ pliers or tweezers
- ▶ glass of cold water
- ▶ heat-proof gloves
- ▶ gas stove burner

Small-Scale Lab, p. 711

- ▶ pencil
- ▶ paper
- ▶ ruler
- ▶ AgNO₃
- ▶ CuSO₄
- ▶ NH₃
- ▶ Na₂S₂O₃
- ▶ Pb(NO₃)₂
- ▶ MgSO₄
- ▶ KSCN
- ▶ CaCl₂
- ▶ AlCl₃
- ▶ FeCl₃
- ▶ ZnCl₂
- ▶ KOH
- ▶ KOH + HNO₃
- ▶ KOH + NaOH
- ▶ reaction surface

Mini Lab p. 735

- ▶ hydrogen peroxide
- ▶ manganese dioxide
- ▶ toothpicks
- ▶ candle
- ▶ matches
- ▶ test tube
- ▶ corks or plastic film wrap
- ▶ tongs

TEACHER'S EDITION

Teacher Demo, p. 708

- ▶ slides or photos of consumer products containing magnesium alloys

Teacher Demo, p. 710

- ▶ 250 mL of 0.1M Ca(OH)₂
- ▶ 250 mL seawater
- ▶ 500-mL beaker

Teacher Demo, p. 716

- ▶ safety goggles
- ▶ hood or well-ventilated room
- ▶ 250-mL beaker
- ▶ 10 mL water
- ▶ 3–4 drops of 0.1% phenolphthalein
- ▶ 30 g of ammonium chloride
- ▶ 15 g sodium hydroxide
- ▶ 500-mL Erlenmeyer flask
- ▶ one-hole stopper
- ▶ glass tube
- ▶ rubber tubing

Activity, p. 725

- ▶ product labels of at least three different brands of multivitamin supplements

Teacher Demo, p. 726

- ▶ dilute aqueous solutions (approx. 0.1M to 0.5M) of different salts of transition metals such as manganese, iron, cobalt, nickel, copper, zinc, and aluminum

Activity, p. 728

- ▶ business sections of newspapers or library references

24.1**THE s-BLOCK ELEMENTS: ACTIVE METALS****SECTION REVIEW****Objectives**

- List sources, properties, and uses for the alkali metals (Group 1A) and their compounds
- Describe the preparation and properties of the alkaline-earth metals (Group 2A) and give uses for their compounds

Key Terms

- lime
- slaked lime

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Group 1A elements are known as the 1 metals. Because 1. _____ of their high chemical reactivity, Group 1A elements never occur as 2. _____ free metals in nature, but are typically combined with nonmetals as 3. _____ 2. Elements in Group 1A have 3 valence electron in 4. _____ their outermost *s* orbital and, therefore, tend to react by losing one 5. _____ electron to form cations with a 1+ charge. For example, pure 6. _____ sodium reacts with water to form 4 and 5. Alkali 7. _____ metals have low densities, low melting points, and high 6 8. _____ conductivity. Metallic sodium can be produced by the electrolysis 9. _____ of molten 7. 8 is an important by-product of this 10. _____ process. 11. _____

The elements in Group 2A, known as the 9 metals 12. _____ are chemically less reactive than the alkali metals. 10 and 11 are the two most common and commercially important elements in Group 2A. Calcium oxide, or lime, and calcium hydroxide, also called 12, have many industrial uses.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 13. Alkali metal salts are very soluble in water.
- _____ 14. Lithium is the most reactive alkali metal.
- _____ 15. The alkali metals react with water to form hydrogen gas.
- _____ 16. Alkaline-earth elements are not found uncombined in nature.
- _____ 17. Sea water is the main source of magnesium compounds.

Part C Matching

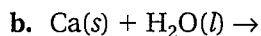
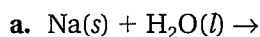
Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ 18. barium	a. common ingredient in products used to clean drains
_____ 19. marble	b. calcium hydroxide, $\text{Ca}(\text{OH})_2$
_____ 20. cesium	c. a form of calcium carbonate, CaCO_3
_____ 21. sodium hydroxide	d. the most reactive alkali metal
_____ 22. slaked lime	e. most reactive alkaline-earth element

Part D Questions and Problems

Answer the following in the space provided.

27. Write balanced equations for each of the following reactions involving Group 1A and Group 2A metals.



24. How does the reactivity of the alkali metals and the alkaline-earth metals change as you proceed down the groups in the periodic table?

24.2

THE *p*-BLOCK ELEMENTS: METALS AND NONMETALS
SECTION REVIEW

Objectives

- Describe properties and uses of *p*-block metals and nonmetals
- Explain methods for obtaining specific *p*-block metals and nonmetals from their compounds and minerals

Key Equations

- Preparation of sulfuric acid:

$$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \xrightleftharpoons{\text{V}_2\text{O}_5} 2\text{SO}_3(\text{g})$$

$$\text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$$
- Haber-Bosch process:

$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- All of the elements in Group 3A can be classified as metals
except 1, which is a metalloid. Boron occurs naturally in the
mineral 2. The most abundant metal in Earth's crust is
3, also a Group 3A element. It is a major component of
many rocks and minerals especially in the form of 4.
Aluminum combines with oxygen to form 5.
- The three allotropes of carbon are 6, 7, and
buckminsterfullerene.
- 80% of the air you breathe is 8, a Group 5A element,
that exists in the free state as 9. Two important nitrogen
compounds are 10 and nitric acid.
- 11 (Group 6A) is the most abundant element in Earth's
crust. Formed in the upper atmosphere, 12 is an allotrope
of oxygen that protects living organisms from UV radiation.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 13. Solder is an alloy of tin and lead.
- _____ 14. Biological organisms use free nitrogen to make nitrogen compounds.
- _____ 15. Oxygen exhibits paramagnetism.
- _____ 16. Sulfur is used in the vulcanization of rubber.
- _____ 17. Fluorine is the strongest reducing agent known.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ 18. lead	a. an element whose ions are needed to prevent thyroid gland disorders
_____ 19. tin	b. an alloy of tin and copper
_____ 20. alloy	c. used for electrodes in automobile batteries
_____ 21. iodine	d. an essential element in living organisms, occurring in bones and DNA
_____ 22. bronze	e. solid mixture composed of two or more elements at least one of which is a metal
_____ 23. phosphorus	f. an element used to line iron cans and an important ingredient in some toothpastes

Part D Questions and Problems

Answer the following in the space provided.

24. Describe the sources, properties, and uses of the halogens and the compounds of these Group 7A elements.

24.3

THE *d*- AND *f*-BLOCK ELEMENTS: TRANSITION AND INNER TRANSITION METALS
SECTION REVIEW**Objectives**

- List the properties of specific transition metals
- Describe the chemical diversity shown by the transition metals and inner transition metals

Key Terms

- ores
- metallurgy
- Monel metal
- inner transition elements

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The transition metals exhibit typical metallic properties: they are 1, 2, and good conductors of heat and electricity.

Several of the transition metals occur in more than one 3.

Transition metals have many important uses. For example, 4 is used to make lightbulb filaments; 5 is used to make thermometers and electrical switches; and 6 is used to make electrical wiring and pipes used in plumbing.

7 is used to galvanize iron. 8 is the second most abundant metal in Earth's crust. Iron is commonly used in industry as an alloy called 9. 10 is the most malleable and ductile of all metals.

The lanthanides and actinides are called the 11 because their seven inner *4f* and *5f* orbitals, respectively, are being filled.

Several of the 12 oxides are used for tinting sunglasses and for the manufacture of high-quality camera lenses. All of the 13 are radioactive and have similar chemical properties.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 14. Your body needs some transition metals to function normally.
- _____ 15. Transition metals are easily oxidized.
- _____ 16. Transition metals are extremely unreactive and resist oxidation.
- _____ 17. Zinc is used to produce galvanized iron.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ 18. stainless steel	a. minerals used for the commercial production of metals
_____ 19. Monel metal	b. a strong corrosion-resistant alloy of nickel and copper
_____ 20. platinum	c. the various procedures used to separate metals from their ores
_____ 21. ores	d. used as a catalyst in many chemical reactions and automobile catalytic converters
_____ 22. metallurgy	e. an alloy that contains about 74% iron, 18% chromium, and 8% nickel plus trace amounts of carbon, manganese, and phosphorus

Part D Questions and Problems

Answer the following in the space provided.

23. Describe the chemical properties, physical properties, and uses of various kinds of steel.

24. What percentage of gold is in an 18-karat gold ring?

24.4

HYDROGEN AND NOBLE GASES

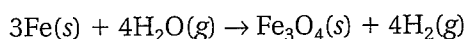
SECTION REVIEW

Objectives

- Show how hydrogen is unique among the elements
- Explain why the noble gases, Group 0, are important even though they are chemically unreactive

Key Equation

- Bosch process:



Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- In some periodic tables, 1 is located at the top of both Groups 1A and 7A because, chemically, hydrogen can behave as either an 2 or a 3. As a result, hydrogen combines with a number of metallic and nonmetallic elements. With bromine, it forms 4; with sodium, it forms 5. 6 is the most abundant hydrogen-containing compound on Earth. The major use of hydrogen is in the manufacture of 7. Liquid hydrogen is used as a 8.
- Because they are extremely unreactive, Group 0 elements, also called 9, generally exist as 10 atoms rather than in combined forms. They were considered completely inert until 1962 when a compound of 11 was prepared.
1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 6. _____
 7. _____
 8. _____
 9. _____
 10. _____
 11. _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 12. There are three isotopes of hydrogen: protium, deuterium, and tritium.
- _____ 13. Hydrogen is the most abundant element in Earth's crust.

_____ 14. Helium is more dense than hydrogen gas.

_____ 15. Radon is a radioactive noble gas that has generated concern as an environmental hazard.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

_____ 16. helium

_____ 17. hydrogenation

_____ 18. hydrogen

_____ 19. inert

_____ 20. neon

_____ 21. electrolysis of water

Column B

a. the process of treating oils with hydrogen to produce shortenings and margarine

b. a process in which electrical energy is used to decompose water into hydrogen gas and oxygen gas

c. the most abundant element in the universe

d. a noble gas that is sometimes mixed with oxygen to provide an artificial atmosphere for deep-sea divers

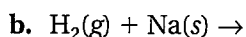
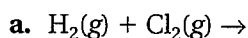
e. unable to react

f. a common noble gas used in gas discharge tubes for commercial signs

Part D Questions and Problems

Answer the following in the space provided.

22. Complete the following equations, then balance them correctly.



23. Explain why, in some periodic tables, hydrogen appears at the top of Group 7A as well as at the top of Group 1A.

INTERPRETING GRAPHICS

USE WITH SECTION 24.4

	88	103
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Figure 1 Periodic table of the elements.

Using colored pencils, annotate the diagram in Figure 1 in a way that will convey information learned in Chapter 24.

1. Use the periodic table in your book to transfer the element symbols to the blank periodic table in Figure 1.
2. Using a black pen, draw the “stair-step” line that separates the metals from the nonmetals.

17	Cl	G
----	----	---

- Using a black pen, write the letter “G,” “S,” or “L” in the lower right hand corner of each element’s box to indicate whether it is a liquid, solid, or gas at room temperature. Are most elements liquids, solids, or gases at room temperature?
- Using one of the colored pencils, shade those boxes which contain alkali metals. Graduate the shade so that the least reactive metal is the lightest and the most reactive metal is the darkest. Excluding francium, which alkali metal is the most reactive? In relative terms, is the electronegativity of this metal greater than or less than fluorine, the most reactive nonmetal? Explain.

5. Select a different color for the alkaline-earth metals and shade as you did for the alkali metals in Step 4. Which alkaline-earth metal is chemically the most stable?
-

6. Select a different color for Group 0. Why does it not make sense to graduate the shading of the Group 0 elements as was done for metals in Steps 4 and 5?
-

7. Select a different color for Group 7A. Again, as in Step 4, graduate the shading to indicate the relative chemical reactivities among the elements. What special name is given to these elements? Characterize the Group 7A elements as reducing agents or oxidizing agents. Which element is the strongest (reducing/oxidizing) agent?
-

8. The elements comprising the *p*-block of the periodic table are a collection of metals, nonmetals, and metalloids. (Semiconductors are metalloids.) Select one color to label the boxes containing metals, another color to label the nonmetals, and a third color to label the metalloids (B, Si, Ge, As, Sb, Te). Name two properties that the metalloids have in common. Which groups are located in the *p*-block? Why are the members of these groups of elements called "*p*-block elements"?
-

9. Color the transition elements all one color and the inner transition elements another color. Which of the transition metals is a liquid at room temperature? Which of the transition metals is often used as a catalyst in chemical reactions?
-

10. Make a key for your color selections and labels such that any other person examining your table can understand what each label and color represents. Refer to the periodic table in the back of your textbook to see an example of a key to a periodic table.

24

VOCABULARY REVIEW

Match the correct vocabulary term to each numbered statement. Write the letter of the correct term on the line provided.

Column A

- _____ 1. an important industrial chemical, commonly called lime, that is produced by the high-temperature decomposition of calcium carbonate
- _____ 2. a strong corrosion-resistant alloy of nickel and copper
- _____ 3. the various procedures used to separate metals from their ores
- _____ 4. a substance, commonly called slaked lime, that is used to make plaster and mortar
- _____ 5. a mineral used for the commercial production of a metal
- _____ 6. an element in the lanthanide and actinide series
- _____ 7. the Group 1A elements; characterized by their low ionization energies and high reactivities
- _____ 8. an alkaline-earth metal, abundant in sea water, that is used to produce high-tensile strength, low-density alloys
- _____ 9. a semiconductor used in making transistors and solar cells
- _____ 10. a strong, lightweight metal, belonging to Group 3A of the periodic table, that is used as a structural material in aircraft production

Column B

- a. Monel metal
- b. calcium oxide (CaO)
- c. inner transition metal
- d. metallurgy
- e. calcium hydroxide [Ca(OH)₂]
- f. ore
- g. silicon
- h. aluminum
- i. alkali metals
- j. magnesium

24**THE CHEMISTRY OF METALS AND NONMETALS****Quiz for CHAPTER 24**

Choose the best answer and write its letter in the blank.

- _____ 1. The most reactive metals known are: 24.1
a. transition metals. c. alkali metals.
b. alkaline earth metals. d. Group 3A metals.
- _____ 2. Alkali metals are generally stored in: 24.1
a. water. c. air.
b. oil or kerosene. d. oxygen.
- _____ 3. The most reactive alkaline earth metal is: 24.1
a. barium. c. beryllium.
b. magnesium. d. calcium.
- _____ 4. Slaked lime has the formula: 24.1
a. CaO . c. CaCO_3 .
b. Ca(OH)_2 . d. CaSO_4 .

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 5. Hydrogen behaves like an alkali metal. 24.4
- _____ 6. Naturally occurring hydrogen is present mostly in the form of tritium. 24.4
- _____ 7. Helium is an explosive element. 24.4
- _____ 8. Transition metals are quite unreactive. 24.3
- _____ 9. Silver is the best conductor of electricity. 24.3

Fill in the word that correctly answers the question.

10. The second most abundant element in Earth's crust is 10. 24.2
11. The Group 5A element that exists in white or red form and that is present in DNA and ATP is 11. 24.2
12. The Group 6A element that can exist in eight-membered rings, in rhombic crystal form, and in a rubber-like allotrope is 12. 24.2
13. The most electronegative and chemically reactive of all nonmetals is 13. 24.2

24

THE CHEMISTRY OF METALS AND NONMETALS

CHAPTER TEST A

Part A Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

- | | |
|------------------------------------|---|
| _____ 1. protium | a. the Group 7A elements |
| _____ 2. lime | b. the Group 0 elements |
| _____ 3. hydrogenation | c. the Group 1A elements |
| _____ 4. organic compounds | d. the most abundant isotope of hydrogen |
| _____ 5. the alkali metals | e. calcium hydroxide |
| _____ 6. halogens | f. treating an oil with hydrogen to convert it into a solid fat |
| _____ 7. the alkaline-earth metals | g. the Group 2A elements |
| _____ 8. ores | h. compounds containing carbon |
| _____ 9. slaked lime | i. calcium oxide |
| _____ 10. noble gases | j. minerals that are used for the commercial production of metals |

B. Multiple Choice

Choose the best answer and write its letter in the blank.

- _____ 11. Among the more than 100 known elements, nonmetals make up:
- | | |
|----------------|----------------|
| a. one-fourth. | c. one-half. |
| b. one-third. | d. two-thirds. |
- _____ 12. Alkali metals are:
- | |
|--------------------------------|
| a. highly reactive. |
| b. found free in nature. |
| c. poor electrical conductors. |
| d. all of the above |
- _____ 13. Calcium and magnesium are:
- | |
|---|
| a. found free in nature. |
| b. alkaline earth elements. |
| c. more reactive than sodium and potassium. |
| d. all of these |

- _____ 14. Which of the following is true about aluminum?
- It corrodes easily.
 - It is a poor conductor of electricity.
 - It is the most abundant metal in Earth's crust.
 - It is found free in nature.
- _____ 15. The basic element of the geologic world is:
- Mg.
 - Si.
 - C.
 - Ca.
- _____ 16. Which of the following is an allotrope of carbon?
- slaked lime
 - borax
 - graphite
 - lime
- _____ 17. Bronze is an alloy of:
- lead and tin.
 - iron and carbon.
 - tin and copper.
 - copper and iron.
- _____ 18. Ammonia is:
- a liquid at room temperature.
 - insoluble in water.
 - a component of many cleaning products.
 - all of these
- _____ 19. Earth's most abundant element is:
- O.
 - C.
 - Al.
 - S.
- _____ 20. Ozone is:
- an allotrope of oxygen.
 - a pale blue gas.
 - a strong oxidizing agent.
 - all of these
- _____ 21. The Ostwald process is used to prepare:
- ammonia.
 - nitric acid.
 - elemental nitrogen.
 - nitroglycerine.
- _____ 22. The common halogens are:
- sulfur, oxygen, and nitrogen.
 - all very reactive.
 - all gases at room temperature.
 - nonmetals of Group 3A.
- _____ 23. Hydrogen is:
- a metal.
 - a good conductor of heat and electricity.
 - shown at the top of Group 7A in some periodic tables
 - not reactive when combined with most halogens.
- _____ 24. The transition metals are:
- ductile.
 - malleable.
 - good conductors of heat and electricity.
 - all of these

- _____ 25. The most widely used metal for electrical wiring is:
- | | |
|--------|--------|
| a. Ag. | c. Ni. |
| b. Cu. | d. Fe. |

C. True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 26. Alkali metals are usually stored under oil or kerosene to keep them from reacting with oxygen and moisture in the air.
- _____ 27. Freshly cut sodium has the typical silvery luster of a metal, but its appearance dulls quickly in air.
- _____ 28. Alkaline-earth carbonates and sulfates are insoluble enough to resist weathering and the leaching action of rainwater.
- _____ 29. At one time, aluminum was very expensive because there was no practical way to produce it.
- _____ 30. The *lead* that makes up the writing substance in a pencil is Pb.
- _____ 31. Tin and lead are very reactive metals.
- _____ 32. About 80% of the air people breathe is oxygen.
- _____ 33. Nitric acid is used in the manufacture of explosives.
- _____ 34. Chlorine is often used in swimming pools to kill disease-producing bacteria.
- _____ 35. Because of their low reactivity, the noble gases have very few uses.
- _____ 36. Iron is the cheapest metal, and, in the form of steel, the most useful.
- _____ 37. Silver is the best conductor of electricity.

D. Questions

Answer the following questions in the space provided.

38. In general, what characteristic accounts for the fact that some elements occur free in nature, while others can only be found in the combined state?

39. Explain why the Group 0 elements are named the noble gases. What structural characteristic of these elements accounts for their unique chemical properties?

E. Essay

Write a short essay in response to the following statement.

40. Distinguish between the alkali metals and the alkaline-earth metals in terms of chemical reactivity, occurrence in nature, storage precautions, and solubility in water.

24

THE CHEMISTRY OF METALS AND NONMETALS

CHAPTER TEST B

A. Matching

Match each term in Column B with the correct description in Column A. Write the letter of the correct term in the blank provided.

Column A

Column B

- | | |
|---|------------------------------|
| _____ 1. the Group 7A elements | a. organic compounds |
| _____ 2. treating an oil with hydrogen to convert it into a solid fat | b. protium |
| _____ 3. the Group 1A elements | c. the alkaline-earth metals |
| _____ 4. minerals that are used for the commercial production of metals | d. ores |
| _____ 5. calcium oxide | e. slaked lime |
| _____ 6. compounds containing carbon | f. halogens |
| _____ 7. the Group 0 elements | g. the alkali metals |
| _____ 8. the Group 2A elements | h. noble gases |
| _____ 9. calcium hydroxide | i. lime |
| _____ 10. the most abundant isotope of hydrogen | j. hydrogenation |

B. Multiple Choice

Choose the best answer and write its letter in the blank.

- _____ 11. Among the more than 100 known elements, metals make up:
a. one-fourth. c. one-half.
b. one-third. d. three-fourths.
- _____ 12. The alkaline-earth metals are:
a. more reactive than the alkali metals.
b. extracted from their mineral ores.
c. stored under oil.
d. found uncombined in nature.
- _____ 13. The fundamental element in the molecules of all living things is:
a. Al. c. C.
b. Si. d. Ca.

- a. Cu.
- b. W.

- c. Fe.
- d. Ni.

C. True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 26. The nonmetallic elements are found at the left side of the periodic table.
- _____ 27. The alkali metals are the most reactive metals known.
- _____ 28. Calcium and magnesium ions are abundant in seawater.
- _____ 29. Aluminum is the most abundant metal in Earth's crust.
- _____ 30. Diamond is the hardest material known.
- _____ 31. Silicon and germanium form the foundation of transistor technology.
- _____ 32. About 80% of the air you breathe is nitrogen.
- _____ 33. Oxygen is paramagnetic.
- _____ 34. Nitric acid is the most widely used industrial chemical.
- _____ 35. The free halogens are relatively nonreactive.
- _____ 36. Noble gases are mixed with oxygen to help deep-sea divers breathe safely.
- _____ 37. Electrical wiring is made of copper.

D. Questions

Answer the following questions in the space provided.

- 38. What characteristic properties of copper, silver, and gold account for the fact that these elements were among the first to be collected and used by humans?

39. Explain why the alkali metals are the most reactive metals known.

E. Essay

Write a short essay in response to the following statement.

40. Distinguish between the halogens and the noble gases in terms of their chemical reactivity, occurrence in nature, and typical uses.

SECTION	STUDENT ACTIVITIES/FEATURES	TEACHER'S RESOURCE PACKAGE
24.1 The s-Block Elements: Active Metals Objectives <ul style="list-style-type: none"> ► List sources, properties, and uses for the alkali metals (Group 1A) and their compounds ► Describe the preparation and properties of the alkaline-earth metals (Group 2A) and give uses for their compounds 	Discover It! <i>Tempering of Metals</i> , p. 704 CHEMath Classification , p. 707 Small-Scale Lab <i>Complex Ions</i> , p. 711	Review Module (Chapters 21–24) <ul style="list-style-type: none"> ► Section Review 24.1 ► Quizzes Laboratory Recordsheet 24-1
24.2 The p-Block Elements: Metals and NonMetals Objectives <ul style="list-style-type: none"> ► Describe properties and uses of <i>p</i>-block metals and nonmetals ► Explain methods for obtaining specific <i>p</i>-block metals and nonmetals from their compounds and minerals 	Link to Oceanography <i>Deep-Sea Minerals</i> , p. 720	Review Module <ul style="list-style-type: none"> ► Section Review 24.2 ► Quizzes Laboratory Manual , Experiment 48: <i>Allotropic Forms of Sulfur</i> Small-Scale Chemistry Lab Manual , Experiment 34: <i>Titration of Bleach</i>
24.3 The d- and f-Block Elements: Transition and Inner Transition Metals Objectives <ul style="list-style-type: none"> ► List the properties of specific transition metals ► Describe the chemical diversity shown by the transition metals and inner transition metals 		Review Module <ul style="list-style-type: none"> ► Section Review 24.3 ► Quizzes Laboratory Manual , Experiment 47: <i>Reactivity of Metals</i> Laboratory Practical 24-1 Small-Scale Chemistry Lab Manual , Experiment 35: <i>Formation of Complex Ions with Ammonia</i>
24.4 Hydrogen and Noble Gases Objectives <ul style="list-style-type: none"> ► Show how hydrogen is unique among the elements ► Explain why the noble gases, Group O, are important even though they are chemically unreactive 	Link to Environmental Awareness <i>Radon Gas</i> , p. 734 Mini Lab <i>Decomposition of Hydrogen Peroxide</i> , p. 735 Chemistry Serving . . . Industry <i>Diamonds are an Engineer's Best Friend</i> , p. 736 Chemistry in Careers <i>Gemologist</i> , p. 736	Review Module <ul style="list-style-type: none"> ► Section Review 24.4 ► Vocabulary Review 24 ► Interpreting Graphics ► Chapter 24 Tests and Quizzes Laboratory Recordsheet 24-2 Solutions Manual for Chapter Reviews Graphing Calculator Problems

PLANNING GUIDE *continued*

TECHNOLOGY RESOURCES

Internet Connections

Within this chapter, you will see the chemSURF logo. If you and your students have access to the Internet, the following URL address will provide various Internet connections that are related to topics and features presented in this chapter.

<http://www.chemsurf.com>



You can also find relevant chapter material at

The Chemistry Place address:

<http://www.chemplace.com>

CD-ROMs

Chem ASAP! CD-ROM

- ▶ Chapter 24

ResourcePro CD-ROM

- ▶ Chapter 24

Assessment Resources CD-ROM

Videodiscs and Videotapes

Chemistry Alive! Videodisc

- ▶ Making Sodium Chloride
- ▶ Watermelon Surprise
- ▶ Elephant Toothpaste
- ▶ Burning Magnesium
- ▶ Chemtoid: Magnesium Fire During Falkland Islands
- ▶ Thermite Reaction
- ▶ Silicon Alien
- ▶ Oxidation States of Vanadium



ASSESSMENT

Student Edition

- ▶ Section Reviews 24.1–24.4
- ▶ Chapter 24 Review, pp. 737–740
- ▶ Alternative Assessment, p. 741

Technology

Chem ASAP! CD-ROM

- ▶ Assessment 24.1–24.4

Assessment Resources CD-ROM

- ▶ Chapter 24 Tests

Teacher's Resource Package

Review Module (Chap. 21–24)

- ▶ Vocabulary Review
- ▶ Chapter 24 Test A and Test B
- ▶ Chapter 24 Quizzes

PLANNING FOR ACTIVITIES

STUDENT EDITION

Discover It! p. 704

- ▶ hairpins
- ▶ pliers or tweezers
- ▶ glass of cold water
- ▶ heat-proof gloves
- ▶ gas stove burner

Small-Scale Lab, p. 711

- ▶ pencil
- ▶ paper
- ▶ ruler
- ▶ AgNO₃
- ▶ CuSO₄
- ▶ NH₃
- ▶ Na₂S₂O₃
- ▶ Pb(NO₃)₂
- ▶ MgSO₄
- ▶ KSCN
- ▶ CaCl₂
- ▶ AlCl₃
- ▶ FeCl₃
- ▶ ZnCl₂
- ▶ KOH
- ▶ KOH + HNO₃
- ▶ KOH + NaOH
- ▶ reaction surface

Mini Lab p. 735

- ▶ hydrogen peroxide
- ▶ manganese dioxide
- ▶ toothpicks
- ▶ candle
- ▶ matches
- ▶ test tube
- ▶ corks or plastic film wrap
- ▶ tongs

TEACHER'S EDITION

Teacher Demo, p. 708

- ▶ slides or photos of consumer products containing magnesium alloys

Teacher Demo, p. 710

- ▶ 250 mL of 0.1M Ca(OH)₂
- ▶ 250 mL seawater
- ▶ 500-mL beaker

Teacher Demo, p. 716

- ▶ safety goggles
- ▶ hood or well-ventilated room
- ▶ 250-mL beaker
- ▶ 10 mL water
- ▶ 3–4 drops of 0.1% phenolphthalein
- ▶ 30 g of ammonium chloride
- ▶ 15 g sodium hydroxide
- ▶ 500-mL Erlenmeyer flask
- ▶ one-hole stopper
- ▶ glass tube
- ▶ rubber tubing

Activity, p. 725

- ▶ product labels of at least three different brands of multivitamin supplements

Teacher Demo, p. 726

- ▶ dilute aqueous solutions (approx. 0.1M to 0.5M) of different salts of transition metals such as manganese, iron, cobalt, nickel, copper, zinc, and aluminum

Activity, p. 728

- ▶ business sections of newspapers or library references

24.1**THE s-BLOCK ELEMENTS: ACTIVE METALS****SECTION REVIEW****Objectives**

- List sources, properties, and uses for the alkali metals (Group 1A) and their compounds
- Describe the preparation and properties of the alkaline-earth metals (Group 2A) and give uses for their compounds

Key Terms

- lime
- slaked lime

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Group 1A elements are known as the 1 metals. Because 1. _____ of their high chemical reactivity, Group 1A elements never occur as 2. _____ free metals in nature, but are typically combined with nonmetals as 3. _____ 2. Elements in Group 1A have 3 valence electron in 4. _____ their outermost s orbital and, therefore, tend to react by losing one 5. _____ electron to form cations with a 1+ charge. For example, pure 6. _____ sodium reacts with water to form 4 and 5. Alkali 7. _____ metals have low densities, low melting points, and high 6 8. _____ conductivity. Metallic sodium can be produced by the electrolysis 9. _____ of molten 7. 8 is an important by-product of this 10. _____ process. 11. _____

The elements in Group 2A, known as the 9 metals 12. _____ are chemically less reactive than the alkali metals. 10 and 11 are the two most common and commercially important elements in Group 2A. Calcium oxide, or lime, and calcium hydroxide, also called 12, have many industrial uses.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 13. Alkali metal salts are very soluble in water.
- _____ 14. Lithium is the most reactive alkali metal.
- _____ 15. The alkali metals react with water to form hydrogen gas.
- _____ 16. Alkaline-earth elements are not found uncombined in nature.
- _____ 17. Sea water is the main source of magnesium compounds.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

- _____ 18. barium
- _____ 19. marble
- _____ 20. cesium
- _____ 21. sodium hydroxide
- _____ 22. slaked lime

Column B

- a. common ingredient in products used to clean drains
- b. calcium hydroxide, $\text{Ca}(\text{OH})_2$
- c. a form of calcium carbonate, CaCO_3
- d. the most reactive alkali metal
- e. most reactive alkaline-earth element

Part D Questions and Problems

Answer the following in the space provided.

27. Write balanced equations for each of the following reactions involving Group 1A and Group 2A metals.
- a. $\text{Na}(s) + \text{H}_2\text{O}(l) \rightarrow$
- b. $\text{Ca}(s) + \text{H}_2\text{O}(l) \rightarrow$
24. How does the reactivity of the alkali metals and the alkaline-earth metals change as you proceed down the groups in the periodic table?
- _____
- _____

24.2

THE *p*-BLOCK ELEMENTS: METALS AND NONMETALS

SECTION REVIEW

Objectives

- Describe properties and uses of *p*-block metals and nonmetals
- Explain methods for obtaining specific *p*-block metals and nonmetals from their compounds and minerals

Key Equations

- Preparation of sulfuric acid:

$$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \xrightleftharpoons{\text{V}_2\text{O}_5} 2\text{SO}_3(\text{g})$$

$$\text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$$
- Haber-Bosch process:

$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- All of the elements in Group 3A can be classified as metals
 except 1, which is a metalloid. Boron occurs naturally in the
 mineral 2. The most abundant metal in Earth's crust is
3, also a Group 3A element. It is a major component of
 many rocks and minerals especially in the form of 4.
 Aluminum combines with oxygen to form 5.
- The three allotropes of carbon are 6, 7, and
 buckminsterfullerene.
- 80% of the air you breathe is 8, a Group 5A element,
 that exists in the free state as 9. Two important nitrogen
 compounds are 10 and nitric acid.
- 11 (Group 6A) is the most abundant element in Earth's
 crust. Formed in the upper atmosphere, 12 is an allotrope
 of oxygen that protects living organisms from UV radiation.
1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 6. _____
 7. _____
 8. _____
 9. _____
 10. _____
 11. _____
 12. _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 13. Solder is an alloy of tin and lead.
- _____ 14. Biological organisms use free nitrogen to make nitrogen compounds.
- _____ 15. Oxygen exhibits paramagnetism.
- _____ 16. Sulfur is used in the vulcanization of rubber.
- _____ 17. Fluorine is the strongest reducing agent known.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ 18. lead	a. an element whose ions are needed to prevent thyroid gland disorders
_____ 19. tin	b. an alloy of tin and copper
_____ 20. alloy	c. used for electrodes in automobile batteries
_____ 21. iodine	d. an essential element in living organisms, occurring in bones and DNA
_____ 22. bronze	e. solid mixture composed of two or more elements at least one of which is a metal
_____ 23. phosphorus	f. an element used to line iron cans and an important ingredient in some toothpastes

Part D Questions and Problems

Answer the following in the space provided.

24. Describe the sources, properties, and uses of the halogens and the compounds of these Group 7A elements.

24.3

THE *d*- AND *f*-BLOCK ELEMENTS: TRANSITION AND INNER TRANSITION METALS
SECTION REVIEW**Objectives**

- List the properties of specific transition metals
- Describe the chemical diversity shown by the transition metals and inner transition metals

Key Terms

- ores
- metallurgy
- Monel metal
- inner transition elements

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The transition metals exhibit typical metallic properties: they are 1, 2, and good conductors of heat and electricity.

Several of the transition metals occur in more than one 3.

Transition metals have many important uses. For example, 4 is used to make lightbulb filaments; 5 is used to make thermometers and electrical switches; and 6 is used to make electrical wiring and pipes used in plumbing.

7 is used to galvanize iron. 8 is the second most abundant metal in Earth's crust. Iron is commonly used in industry as an alloy called 9. 10 is the most malleable and ductile of all metals.

The lanthanides and actinides are called the 11 because their seven inner *4f* and *5f* orbitals, respectively, are being filled.

Several of the 12 oxides are used for tinting sunglasses and for the manufacture of high-quality camera lenses. All of the 13 are radioactive and have similar chemical properties.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 14. Your body needs some transition metals to function normally.
- _____ 15. Transition metals are easily oxidized.
- _____ 16. Transition metals are extremely unreactive and resist oxidation.
- _____ 17. Zinc is used to produce galvanized iron.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ 18. stainless steel	a. minerals used for the commercial production of metals
_____ 19. Monel metal	b. a strong corrosion-resistant alloy of nickel and copper
_____ 20. platinum	c. the various procedures used to separate metals from their ores
_____ 21. ores	d. used as a catalyst in many chemical reactions and automobile catalytic converters
_____ 22. metallurgy	e. an alloy that contains about 74% iron, 18% chromium, and 8% nickel plus trace amounts of carbon, manganese, and phosphorus

Part D Questions and Problems

Answer the following in the space provided.

23. Describe the chemical properties, physical properties, and uses of various kinds of steel.

24. What percentage of gold is in an 18-karat gold ring?

24.4

HYDROGEN AND NOBLE GASES

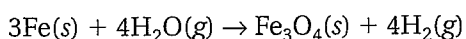
SECTION REVIEW

Objectives

- Show how hydrogen is unique among the elements
- Explain why the noble gases, Group 0, are important even though they are chemically unreactive

Key Equation

- Bosch process:



Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- In some periodic tables, 1 is located at the top of both 1. _____
- Groups 1A and 7A because, chemically, hydrogen can behave as 2. _____
- either an 2 or a 3. As a result, hydrogen combines 3. _____
- with a number of metallic and nonmetallic elements. With 4. _____
- bromine, it forms 4; with sodium, it forms 5. 5. _____
- 6 is the most abundant hydrogen-containing compound on 6. _____
- Earth. The major use of hydrogen is in the manufacture of 7. 7. _____
- Liquid hydrogen is used as a 8. 8. _____
- Because they are extremely unreactive, Group 0 elements, 9. _____
- also called 9, generally exist as 10 atoms rather than 10. _____
- in combined forms. They were considered completely inert until 11. _____
- 1962 when a compound of 11 was prepared.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

12. There are three isotopes of hydrogen: protium, deuterium, and tritium.
13. Hydrogen is the most abundant element in Earth's crust.

_____ 14. Helium is more dense than hydrogen gas.

_____ 15. Radon is a radioactive noble gas that has generated concern as an environmental hazard.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

_____ 16. helium

a. the process of treating oils with hydrogen to produce shortenings and margarine

_____ 17. hydrogenation

b. a process in which electrical energy is used to decompose water into hydrogen gas and oxygen gas

_____ 18. hydrogen

c. the most abundant element in the universe

_____ 19. inert

d. a noble gas that is sometimes mixed with oxygen to provide an artificial atmosphere for deep-sea divers

_____ 20. neon

e. unable to react

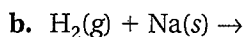
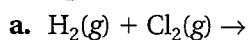
_____ 21. electrolysis of water

f. a common noble gas used in gas discharge tubes for commercial signs

Part D Questions and Problems

Answer the following in the space provided.

22. Complete the following equations, then balance them correctly.



23. Explain why, in some periodic tables, hydrogen appears at the top of Group 7A as well as at the top of Group 1A.

USE WITH SECTION 24.4

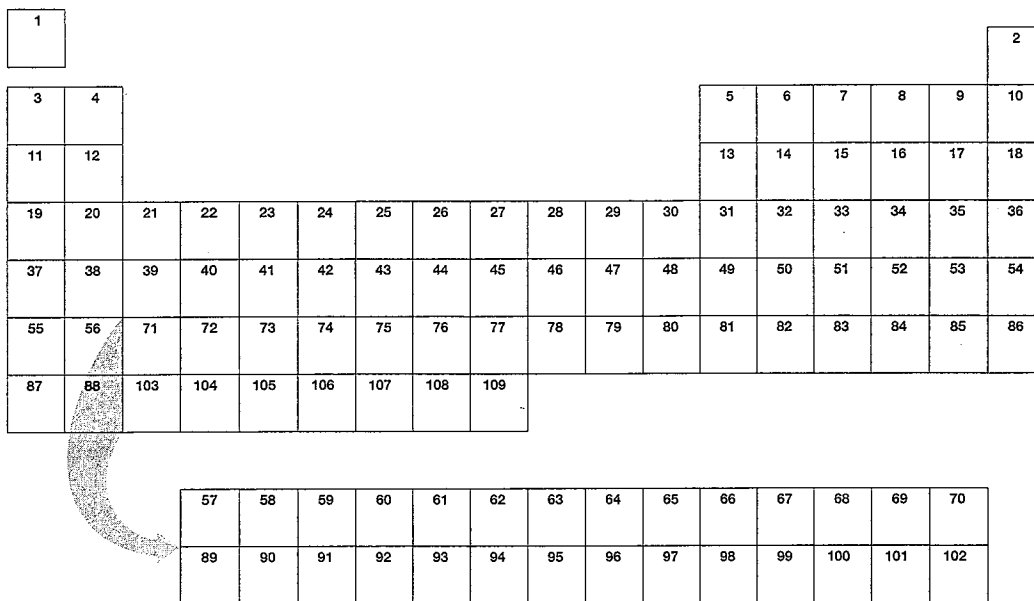


Figure 1 Periodic table of the elements.

Using colored pencils, annotate the diagram in Figure 1 in a way that will convey information learned in Chapter 24.

1. Use the periodic table in your book to transfer the element symbols to the blank periodic table in Figure 1.
2. Using a black pen, draw the “stair-step” line that separates the metals from the nonmetals.

17	Cl	G
----	----	---

- Using a black pen, write the letter “G,” “S,” or “L” in the lower right hand corner of each element’s box to indicate whether it is a liquid, solid, or gas at room temperature. Are most elements liquids, solids, or gases at room temperature?
- Using one of the colored pencils, shade those boxes which contain alkali metals. Graduate the shade so that the least reactive metal is the lightest and the most reactive metal is the darkest. Excluding francium, which alkali metal is the most reactive? In relative terms, is the electronegativity of this metal greater than or less than fluorine, the most reactive nonmetal? Explain.

5. Select a different color for the alkaline-earth metals and shade as you did for the alkali metals in Step 4. Which alkaline-earth metal is chemically the most stable?

6. Select a different color for Group 0. Why does it not make sense to graduate the shading of the Group 0 elements as was done for metals in Steps 4 and 5?

7. Select a different color for Group 7A. Again, as in Step 4, graduate the shading to indicate the relative chemical reactivities among the elements. What special name is given to these elements? Characterize the Group 7A elements as reducing agents or oxidizing agents. Which element is the strongest (reducing/oxidizing) agent?

8. The elements comprising the *p*-block of the periodic table are a collection of metals, nonmetals, and metalloids. (Semiconductors are metalloids.) Select one color to label the boxes containing metals, another color to label the nonmetals, and a third color to label the metalloids (B, Si, Ge, As, Sb, Te). Name two properties that the metalloids have in common. Which groups are located in the *p*-block? Why are the members of these groups of elements called "*p*-block elements"?

9. Color the transition elements all one color and the inner transition elements another color. Which of the transition metals is a liquid at room temperature? Which of the transition metals is often used as a catalyst in chemical reactions?

10. Make a key for your color selections and labels such that any other person examining your table can understand what each label and color represents. Refer to the periodic table in the back of your textbook to see an example of a key to a periodic table.

24

VOCABULARY REVIEW

Match the correct vocabulary term to each numbered statement. Write the letter of the correct term on the line provided.

Column A

- _____ 1. an important industrial chemical, commonly called lime, that is produced by the high-temperature decomposition of calcium carbonate
- _____ 2. a strong corrosion-resistant alloy of nickel and copper
- _____ 3. the various procedures used to separate metals from their ores
- _____ 4. a substance, commonly called slaked lime, that is used to make plaster and mortar
- _____ 5. a mineral used for the commercial production of a metal
- _____ 6. an element in the lanthanide and actinide series
- _____ 7. the Group 1A elements; characterized by their low ionization energies and high reactivities
- _____ 8. an alkaline-earth metal, abundant in sea water, that is used to produce high-tensile strength, low-density alloys
- _____ 9. a semiconductor used in making transistors and solar cells
- _____ 10. a strong, lightweight metal, belonging to Group 3A of the periodic table, that is used as a structural material in aircraft production

Column B

- a. Monel metal
- b. calcium oxide (CaO)
- c. inner transition metal
- d. metallurgy
- e. calcium hydroxide [Ca(OH)₂]
- f. ore
- g. silicon
- h. aluminum
- i. alkali metals
- j. magnesium

24**THE CHEMISTRY OF METALS AND NONMETALS****Quiz for CHAPTER 24**

Choose the best answer and write its letter in the blank.

- _____ 1. The most reactive metals known are: 24.1
a. transition metals. c. alkali metals.
b. alkaline earth metals. d. Group 3A metals.
- _____ 2. Alkali metals are generally stored in: 24.1
a. water. c. air.
b. oil or kerosene. d. oxygen.
- _____ 3. The most reactive alkaline earth metal is: 24.1
a. barium. c. beryllium.
b. magnesium. d. calcium.
- _____ 4. Slaked lime has the formula: 24.1
a. CaO . c. CaCO_3 .
b. Ca(OH)_2 . d. CaSO_4 .

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 5. Hydrogen behaves like an alkali metal. 24.4
- _____ 6. Naturally occurring hydrogen is present mostly in the form of tritium. 24.4
- _____ 7. Helium is an explosive element. 24.4
- _____ 8. Transition metals are quite unreactive. 24.3
- _____ 9. Silver is the best conductor of electricity. 24.3

Fill in the word that correctly answers the question.

10. The second most abundant element in Earth's crust is 10. 10. _____ 24.2
11. The Group 5A element that exists in white or red form and that is present in DNA and ATP is 11. 11. _____ 24.2
12. The Group 6A element that can exist in eight-membered rings, in rhombic crystal form, and in a rubber-like allotrope is 12. 12. _____ 24.2
13. The most electronegative and chemically reactive of all nonmetals is 13. 13. _____ 24.2

24

THE CHEMISTRY OF METALS AND NONMETALS

CHAPTER TEST A

Part A Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

- | | |
|------------------------------------|---|
| _____ 1. protium | a. the Group 7A elements |
| _____ 2. lime | b. the Group 0 elements |
| _____ 3. hydrogenation | c. the Group 1A elements |
| _____ 4. organic compounds | d. the most abundant isotope of hydrogen |
| _____ 5. the alkali metals | e. calcium hydroxide |
| _____ 6. halogens | f. treating an oil with hydrogen to convert it into a solid fat |
| _____ 7. the alkaline-earth metals | g. the Group 2A elements |
| _____ 8. ores | h. compounds containing carbon |
| _____ 9. slaked lime | i. calcium oxide |
| _____ 10. noble gases | j. minerals that are used for the commercial production of metals |

B. Multiple Choice

Choose the best answer and write its letter in the blank.

- _____ 11. Among the more than 100 known elements, nonmetals make up:
- | | |
|----------------|----------------|
| a. one-fourth. | c. one-half. |
| b. one-third. | d. two-thirds. |
- _____ 12. Alkali metals are:
- | |
|--------------------------------|
| a. highly reactive. |
| b. found free in nature. |
| c. poor electrical conductors. |
| d. all of the above |
- _____ 13. Calcium and magnesium are:
- | |
|---|
| a. found free in nature. |
| b. alkaline earth elements. |
| c. more reactive than sodium and potassium. |
| d. all of these |

- _____ 14. Which of the following is true about aluminum?
- It corrodes easily.
 - It is a poor conductor of electricity.
 - It is the most abundant metal in Earth's crust.
 - It is found free in nature.
- _____ 15. The basic element of the geologic world is:
- Mg.
 - Si.
 - C.
 - Ca.
- _____ 16. Which of the following is an allotrope of carbon?
- slaked lime
 - borax
 - graphite
 - lime
- _____ 17. Bronze is an alloy of:
- lead and tin.
 - iron and carbon.
 - tin and copper.
 - copper and iron.
- _____ 18. Ammonia is:
- a liquid at room temperature.
 - insoluble in water.
 - a component of many cleaning products.
 - all of these
- _____ 19. Earth's most abundant element is:
- O.
 - C.
 - Al.
 - S.
- _____ 20. Ozone is:
- an allotrope of oxygen.
 - a pale blue gas.
 - a strong oxidizing agent.
 - all of these
- _____ 21. The Ostwald process is used to prepare:
- ammonia.
 - nitric acid.
 - elemental nitrogen.
 - nitroglycerine.
- _____ 22. The common halogens are:
- sulfur, oxygen, and nitrogen.
 - all very reactive.
 - all gases at room temperature.
 - nonmetals of Group 3A.
- _____ 23. Hydrogen is:
- a metal.
 - a good conductor of heat and electricity.
 - shown at the top of Group 7A in some periodic tables
 - not reactive when combined with most halogens.
- _____ 24. The transition metals are:
- ductile.
 - malleable.
 - good conductors of heat and electricity.
 - all of these

- _____ 25. The most widely used metal for electrical wiring is:
- | | |
|--------|--------|
| a. Ag. | c. Ni. |
| b. Cu. | d. Fe. |

C. True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 26. Alkali metals are usually stored under oil or kerosene to keep them from reacting with oxygen and moisture in the air.
- _____ 27. Freshly cut sodium has the typical silvery luster of a metal, but its appearance dulls quickly in air.
- _____ 28. Alkaline-earth carbonates and sulfates are insoluble enough to resist weathering and the leaching action of rainwater.
- _____ 29. At one time, aluminum was very expensive because there was no practical way to produce it.
- _____ 30. The *lead* that makes up the writing substance in a pencil is Pb.
- _____ 31. Tin and lead are very reactive metals.
- _____ 32. About 80% of the air people breathe is oxygen.
- _____ 33. Nitric acid is used in the manufacture of explosives.
- _____ 34. Chlorine is often used in swimming pools to kill disease-producing bacteria.
- _____ 35. Because of their low reactivity, the noble gases have very few uses.
- _____ 36. Iron is the cheapest metal, and, in the form of steel, the most useful.
- _____ 37. Silver is the best conductor of electricity.

D. Questions

Answer the following questions in the space provided.

38. In general, what characteristic accounts for the fact that some elements occur free in nature, while others can only be found in the combined state?

39. Explain why the Group 0 elements are named the noble gases. What structural characteristic of these elements accounts for their unique chemical properties?

E. Essay

Write a short essay in response to the following statement.

40. Distinguish between the alkali metals and the alkaline-earth metals in terms of chemical reactivity, occurrence in nature, storage precautions, and solubility in water.

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THE CHEMISTRY OF METALS AND NONMETALS

CHAPTER TEST B

A. Matching

Match each term in Column B with the correct description in Column A. Write the letter of the correct term in the blank provided.

Column A

- _____ 1. the Group 7A elements
- _____ 2. treating an oil with hydrogen to convert it into a solid fat
- _____ 3. the Group 1A elements
- _____ 4. minerals that are used for the commercial production of metals
- _____ 5. calcium oxide
- _____ 6. compounds containing carbon
- _____ 7. the Group 0 elements
- _____ 8. the Group 2A elements
- _____ 9. calcium hydroxide
- _____ 10. the most abundant isotope of hydrogen

Column B

- a. organic compounds
- b. protium
- c. the alkaline-earth metals
- d. ores
- e. slaked lime
- f. halogens
- g. the alkali metals
- h. noble gases
- i. lime
- j. hydrogenation

B. Multiple Choice

Choose the best answer and write its letter in the blank.

- _____ 11. Among the more than 100 known elements, metals make up:
 - a. one-fourth.
 - b. one-third.
 - c. one-half.
 - d. three-fourths.
- _____ 12. The alkaline-earth metals are:
 - a. more reactive than the alkali metals.
 - b. extracted from their mineral ores.
 - c. stored under oil.
 - d. found uncombined in nature.
- _____ 13. The fundamental element in the molecules of all living things is:
 - a. Al.
 - b. Si.
 - c. C.
 - d. Ca.

- a. Cu.
- b. W.

- c. Fe.
- d. Ni.

C. True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 26. The nonmetallic elements are found at the left side of the periodic table.
- _____ 27. The alkali metals are the most reactive metals known.
- _____ 28. Calcium and magnesium ions are abundant in seawater.
- _____ 29. Aluminum is the most abundant metal in Earth's crust.
- _____ 30. Diamond is the hardest material known.
- _____ 31. Silicon and germanium form the foundation of transistor technology.
- _____ 32. About 80% of the air you breathe is nitrogen.
- _____ 33. Oxygen is paramagnetic.
- _____ 34. Nitric acid is the most widely used industrial chemical.
- _____ 35. The free halogens are relatively nonreactive.
- _____ 36. Noble gases are mixed with oxygen to help deep-sea divers breathe safely.
- _____ 37. Electrical wiring is made of copper.

D. Questions

Answer the following questions in the space provided.

- 38. What characteristic properties of copper, silver, and gold account for the fact that these elements were among the first to be collected and used by humans?

39. Explain why the alkali metals are the most reactive metals known.

E. Essay

Write a short essay in response to the following statement.

40. Distinguish between the halogens and the noble gases in terms of their chemical reactivity, occurrence in nature, and typical uses.
