Name ______________ Date ______________ Class ______________

6 THE PERIODIC TABLE

SECTION 6.1 ORGANIZING THE ELEMENTS (pages 155–160)

This section describes the development of the periodic table and explains the periodic law. It also describes the classification of elements into metals, nonmetals, and metalloids.

▶ Searching For An Organizing Principle (page 155)

1. How many elements had been identified by the year 1700? 13

2. What caused the rate of discovery to increase after 1700?

Chemists began to use scientific methods to search for elements.

3. What did chemists use to sort elements into groups?

Chemists used the properties of elements.

▶ Mendeleev's Periodic Table (page 156)

4. Who was Dmitri Mendeleev? Dmitri Mendeleev was a Russian chemist and teacher who developed a periodic table of elements.

5. What property did Mendeleev use to organize the elements into a periodic table?

Mendeleev arranged the elements in order of increasing atomic mass.

6. Is the following sentence true or false? Mendeleev used his periodic table to predict the properties of undiscovered elements. true

▶ The Periodic Law (page 157)

7. How are the elements arranged in the modern periodic table?

The elements are arranged in order by increasing atomic number.

8. Is the following statement true or false? The periodic law states that when elements are arranged in order of increasing atomic number, there is a periodic repetition of physical and chemical properties. true

▶ Metals, Nonmetals, and Metalloids (pages 158–160)

9. Explain the color coding of the squares in the periodic table in Figure 6.5.

Yellow squares contain metals, blue squares contain nonmetals, green squares contain metalloids.

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CHAPTER 6, The Periodic Table *(continued)*

10. Which property below is not a general property of metals.

a. ductile **c.** malleable

b. poor conductor of heat **d.** high luster

11. Is the following statement true or false? The variation in properties among metals is greater than the variation in properties among nonmetals. false

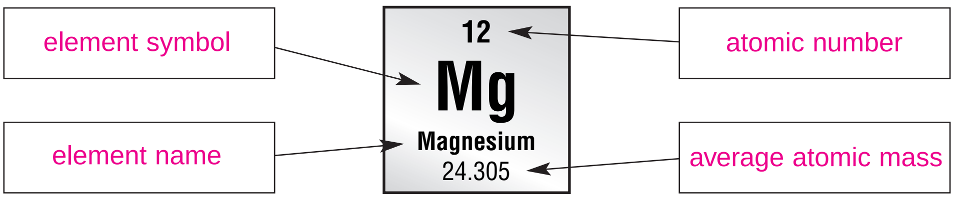
12. Under some conditions, a metalloid may behave like a metal.
Under other conditions, a metalloid may behave like a nonmetal.

SECTION 6.2 CLASSIFYING THE ELEMENTS (pages 161–167)

This section explains why you can infer the properties of an element based on the properties of other elements in the periodic table. It also describes the use of electron configurations to classify elements.

▶ Squares In The Periodic Table (pages 161–163)

1. Label the sample square from the periodic table below. Use the labels *element name, element symbol, atomic number,* and *average atomic mass.*



2. List three things, other than the name, symbol, atomic number, and average atomic mass, you can discover about an element using the periodic table in Figure 6.9.

a. state at room temperature

b. electrons in each energy level

c. whether an element is found in nature

▶ Electron Configurations In Groups (pages 164–165)

3. Is the following sentence true or false? The subatomic particles that play the key role in determining the properties of an element are electrons. true

4. Why are Group A elements called representative elements?

They exhibit a wide range of physical and chemical properties.

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5. Classify each of the following elements as a (an) *alkali metal, alkaline earth metal, halogen,* or *noble gas.*

a. sodium alkali metal

b. chlorine halogen

c. calcium alkaline earth metal

d. fluorine halogen

e. xenon noble gas

f. potassium alkali metal

g. magnesium alkaline earth metal

6. For elements in each of the following groups, how many electrons are in the highest occupied energy level?

a. Group 3A 3

b. Group 1A 1

c. Group 8A 8

▶ Transition Elements (page 166)

7. Complete the table about classifying elements according to the electron configuration of their highest occupied energy level.

Category	Description of Electron Configuration
Noble gases	*s* or *p* sublevels are filled
Representative elements	*s* or *p* sublevels are only partially filled
Transition metals	*s* sublevel and nearby *d* sublevel contain electrons
Inner transition metals	*s* sublevel and nearby *f* sublevel contain electrons

8. Circle the letter of the elements found in the *p* block.

a. Groups 1A and 2A and helium

b. Groups 3A, 4A, 5A, 6A, 7A, and 8A except for helium

c. transition metals

d. inner transition metals

Match the category of elements with an element from that category.

c **9.** Noble gases

a **10.** Representative elements

d **11.** Transition metals

b **12.** Inner transition metals

a. gallium

b. nobelium

c. argon

d. vanadium

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13. Use Figure 6.12 on page 166. Write the electron configurations for the following elements.

a. magnesium $1s^2 2s^2 2p^6 3s^2$

b. cobalt $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$

c. sulfur $1s^2 2s^2 2p^6 3s^2 3p^4$

SECTION 6.3 PERIODIC TRENDS (pages 170–178)

This section explains how to interpret group trends and periodic trends in atomic size, ionization energy, ionic size, and electronegativity.

▶ Trends in Atomic Size (pages 170–171)

1. Is the following sentence true or false? The radius of an atom can be measured directly. false

2. What are the atomic radii for the following molecules?

Hydrogen	Oxygen	Nitrogen	Chlorine
atomic radius =	atomic radius =	atomic radius =	atomic radius =
30 pm	68 pm	70 pm	102 pm

3. What is the general trend in atomic size within a group? Within a period?

The atomic size increases within a group as atomic number increases. The atomic size decreases from left to right across a period.

4. What are the two variables that affect atomic size within a group?

a. the charge on the nucleus

b. the number of occupied energy levels

5. For each pair of elements, pick the element with the largest atom.

a. Helium and argon argon

b. Potassium and argon potassium

▶ Ions (page 172)

6. What is an ion?

An ion is an atom or group of atoms that has a positive or negative charge.

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7. How are ions formed?

An ion is formed when electrons are transferred between atoms.

8. An ion with a positive charge is called a(n) ___anion___ ; an ion with a negative charge is called a(n) ___cation___ .

9. Complete the table about anions and cations.

	Anions	Cations
Charge	negative	positive
Metal/Nonmetal	nonmetal	metal
Minus sign/Plus sign	plus sign	minus sign

▶ Trends in Ionization Energy (pages 173–175)

10. ___Ionization energy___ is the energy required to overcome the attraction of protons in the nucleus and remove an electron from a gaseous atom.

11. Why does ionization energy tend to decrease from top to bottom within a group?

Atomic size increases from top to bottom within the group. The nuclear charge has a smaller effect on the electrons in the highest occupied energy level and less energy is required to remove an electron.

12. Why does ionization energy tend to increase as you move across a period?

The nuclear charge increases across a period but the shielding effect remains constant. There is greater attraction of the electrons to the nucleus and more energy is required to remove an electron. Atomic size increases from top to bottom within the group.

13. There is a large increase in ionization energy between the second and the third ionization energies of a metal. What kind of ion is the metal likely to form? Include the charge in your answer.

an ion with a 2+ charge

▶ Trends in Ionic Size (page 176)

14. Metallic elements tend to ___lose___ electrons and form ___positive___ ions.

Nonmetallic elements tend to ___gain___ electrons and form ___negative___ ions.

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CHAPTER 6, The Periodic Table *(continued)*

15. Circle the letter of the statement that is true about ion size.

a. Cations are always smaller than the neutral atoms from which they form.

b. Anions are always smaller than the neutral atoms from which they form.

c. Within a period, a cation with a greater charge has a larger ionic radius.

d. Within a group, a cation with a higher atomic number has a smaller ionic radius.

16. Which ion has the larger ionic radius: Ca^{2+} or Cl^- ? Cl^-

Trends in Electronegativity (page 177)

17. What property of an element represents its tendency to attract electrons when it chemically combines with another element? electronegativity

18. Use Table 6.2 on page 177. What trend do you see in the relative electronegativity values of elements within a group? Within a period?

The electronegativity values decrease as you move down a group, but increase as you move across a period.

19. Circle the letter of each statement that is true about electronegativity values.

a. The electronegativity values of the transition elements are all zero.

b. The element with the highest electronegativity value is sodium.

c. Nonmetals have higher electronegativity values than metals.

d. Electronegativity values can help predict the types of bonds atoms form.

Summary of Trends (page 178)

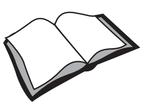
20. Use Figure 6.22 on page 178. Circle the letter of each property for which aluminum has a higher value than silicon.

a. first ionization energy

b. atomic radius

c. electronegativity

d. ionic radius



Reading Skill Practice

A graph can help you understand comparisons of data at a glance. Use graph paper to make a graph of the data in Table 6.2 on page 177. Plot electronegativity values on the vertical axis. Use a range from 0 to 4. Plot atomic number on the horizontal axis. Label each period and the first element in each period.

Students' graphs should show a trend of increasing electronegativity values within a period as atomic number increases, and a dramatic decrease in the electronegativity value between the Group 7A element in one period and the group 1A element in the next period.

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GUIDED PRACTICE PROBLEM

GUIDED PRACTICE PROBLEM 8 (page 167)

8. Use Figure 6.9 and Figure 6.12 to write the electron configurations of these elements.

a. carbon **b.** strontium **c.** vanadium

Analyze

a. What is the number of electrons for each element?

C 6 Sr 38 V 23

b. What is the highest occupied energy sublevel for each element, according to its position on the periodic table? Remember that the energy level for the *d* block is always one less than the period.

C $2p$ Sr $5s$ V $3d$

c. According to its position on the periodic table, how many electrons does each element have in the sublevel listed above?

C 2 Sr 2 V 3

Solve

d. Begin filling in electron sublevels. Start from the top left and move right across each period in Figure 6.12 until you reach the highest occupied sublevel for each element. Make sure the *d*-block is in the correct energy level.

C $1s^2 2s^2 2p^2$ Sr $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$

V $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$

e. How can you check whether your answers are correct?

Add all the superscripts in the electron configurations. This sum should be equal to the atomic number for that element.

f. Check your answers as outlined above.

C $2 + 2 + 2 = 6$, equal to the atomic number

Sr $2 + 2 + 6 + 2 + 6 + 10 + 2 + 6 + 2 = 38$, equal to the atomic number

V $2 + 2 + 6 + 2 + 6 + 3 + 2 = 23$, equal to the atomic number

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