

15.1

ELECTRON CONFIGURATION IN IONIC BONDING

SECTION REVIEW

Objectives

- Use the periodic table to infer the number of valence electrons in an atom and draw its electron dot structure
- Describe the formation of cations from metals and of anions from nonmetals

Key Terms

- valence electrons
- octet rule
- electron dot structures
- halide ions

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.

- Elements within the same group of the periodic table behave **1.** _____ similarly because they have the same number of **1**. The **2.** _____ **2** number of a representative element indicates how many **3.** _____ valence electrons that element has. Gilbert Lewis's **3** states **4.** _____ that in forming compounds, atoms tend to achieve the electron **5.** _____ configuration of a noble gas. **6.** _____
- Atoms are held together in **4** by chemical bonds. The **7.** _____ transfer of valence electrons produces positively charged ions, or **8.** _____ **5**, and negatively charged ions called **6**. The cations **9.** _____ of Group 1A elements always have a charge of **7**. **8** **10.** _____ are produced when atoms of the elements in Group 7A **9** an electron. For transition metals, the **10** of cations may vary.

Part B True-False

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

- _____ **11.** The chlorine atom gains seven electrons when it becomes an ion.
- _____ **12.** The chemical properties of an element are largely determined by the number of valence electrons the element has.

- _____ 13. Atoms acquire the stable electron structure of a noble gas by losing electrons.
- _____ 14. An atom of each alkali metal has seven valence electrons.
- _____ 15. Among the representative elements, the group number of each element is equal to the number of valence electrons in that element.
- _____ 16. Sulfur and magnesium both have two valence electrons.

Part C Matching

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

Column A	Column B
_____ 17. electron dot structure	a. ions that are produced when halogens gain electrons
_____ 18. valence electron	b. a depiction of valence electrons around the symbol of an element
_____ 19. octet rule	c. has the electron configuration of argon
_____ 20. halide ions	d. an electron in the highest occupied energy level of an atom
_____ 21. chloride ion	e. atoms in compounds tend to have the electron configuration of a noble gas

Part D Questions and Problems

Answer the following in the space provided.

22. Write the electron dot configurations for the following atoms:

- a. silicon _____
- b. rubidium _____
- c. barium _____

23. Describe the formation of an ion from a metal and a nonmetal using the octet rule and the importance of noble gas electron configurations.

15.2

IONIC BONDS

SECTION REVIEW

Objectives

- List the characteristics of an ionic bond
- Use the characteristics of ionic compounds to explain the electrical conductivity of ionic compounds when melted and when in aqueous solutions

Key Terms

- ionic bonds
- coordination number

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.

Anions and cations attract one another by 1. The forces **1.** _____
of attraction that bind these 2 charged ions are called **2.** _____
3. Compounds that consist of electrically 4 groups **3.** _____
of ions joined by electrostatic forces are called 5. **4.** _____
Nearly all ionic compounds are 6 solids at room **5.** _____
temperature. Ionic compounds in general have very 7 **6.** _____
melting temperatures. This is because the 8 attractive **7.** _____
forces between the ions result in a very 9 structure. **8.** _____
Ionic compounds conduct an electric current when in the **9.** _____
10 state. **10.** _____

Part B True-False

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

- _____ **11.** During the formation of the compound NaCl, one electron is transferred from a sodium atom to a chlorine atom.
- _____ **12.** The coordination number of an ion is the number of ions of positive charge that surround the ion in a crystal.
- _____ **13.** The coordination number of the ion Na^+ in NaCl is 6.

- _____ 14. Patterns from x-ray diffraction crystallography are used to determine the structure of the crystal.
- _____ 15. Ionic compounds cannot conduct electricity if they are dissolved in water.

Part C Matching

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

Column A	Column B
_____ 16. ionic bonds	a. the number of ions of opposite charge surrounding each ion in a crystal
_____ 17. electrostatic forces	b. compounds composed of cations and anions
_____ 18. face-centered cubic	c. the unit cell of the cubic crystals of NaCl
_____ 19. ionic compounds	d. the type of force exerted by cations and anions
_____ 20. coordination number	e. the forces of attraction binding oppositely charged ions together

Part D Questions and Problems

Answer the following in the space provided.

21. List the characteristics of an ionic bond.

22. Explain the electrical conductivity of melted and of aqueous solutions of ionic compounds using the characteristics of ionic compounds.

15.3

BONDING IN METALS

SECTION REVIEW

Objectives

- Use the theory of metallic bonds to explain the physical properties of metals
- Describe the arrangements of atoms in some common metallic crystal structures

Key Terms

- metallic bonds

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.

- Metals consist of closely packed 1 that are surrounded **1.** _____
- by a sea of their 2. This arrangement constitutes the **2.** _____
- 3 bond. The electron mobility accounts for the **3.** _____
- excellent 4 conductivity of metals and helps explain why **4.** _____
- metals are 5 and 6. Metal atoms are commonly **5.** _____
- packed in a 7 cubic, a 8 cubic, or a 9 **6.** _____
- arrangement. When two or more elements, at least one of which **7.** _____
- is a metal, are mixed together, the resulting mixture is called **8.** _____
- an 10. **9.** _____
- 10.** _____

Part B True-False

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

- _____ **11.** In a body-centered cubic structure, each atom has 12 neighbors.
- _____ **12.** Metallic objects are formed from pure metals.
- _____ **13.** When metals are good conductors of electricity, they are said to be ductile.
- _____ **14.** Drifting valence electrons insulate cations from one another and contribute to the malleability of a metal.

_____ 15. Metals are good conductors of electricity because electrons can flow freely in them.

Part C Matching

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

Column A	Column B
_____ 16. ductile	a. an alloy whose component atoms are different sizes
_____ 17. metallic bonds	b. a mixture of two or more elements, at least one of which is a metal
_____ 18. alloy	c. can be hammered or forced into shapes
_____ 19. malleable	d. can be drawn into wires
_____ 20. interstitial alloy	e. the attraction of valence electrons for positive metal ions

Part D Questions and Problems

Answer the following in the space provided.

21. Explain the physical properties of metals using the theory of metallic bonding.

22. Explain why the properties of alloys are generally superior to their constituent components.
