

# 7.1 IONS

## Section Review

### Objectives

- Determine the number of valence electrons in an atom of a representative element
- Explain the octet rule
- Describe how cations form
- Explain how anions form

### Vocabulary

- valence electrons
- electron dot structures
- octet rule
- 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 similarly because they have the same number of 1. The 2 number of a representative element indicates how many valence electrons that element has. Diagrams that show valence electrons as dots are called 3. Gilbert Lewis's 4 states that in forming compounds, atoms tend to achieve the electron configuration of a noble gas.

The transfer of valence electrons produces positively charged ions, or 5, and negatively charged ions called 6. The cations of Group 1A elements always have a charge of 7. 8 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 an element in Group 1A has seven valence electrons.
- \_\_\_\_\_ 15. Among the Group 1A and 2A elements, the group number of each element is equal to the number of valence electrons in an atom of 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

- \_\_\_\_\_ 17. electron dot structure
- \_\_\_\_\_ 18. valence electron
- \_\_\_\_\_ 19. octet rule
- \_\_\_\_\_ 20. cations
- \_\_\_\_\_ 21. anions
- \_\_\_\_\_ 22. halide ions
- \_\_\_\_\_ 23. chloride ion

### Column B

- a. ions that are produced when halogens gain electrons
- b. a depiction of valence electrons around the symbol of an element
- c. has the electron configuration of argon
- d. an electron in the highest occupied energy level of an element's atom
- e. Atoms in compounds tend to have the electron configuration of a noble gas.
- f. atoms or groups of atoms with a negative charge
- g. atoms or groups of atoms with a positive charge

## Part D Questions and Problems

Answer the following in the space provided.

24. Write the electron dot structures for the following atoms.
- a. silicon \_\_\_\_\_
- b. rubidium \_\_\_\_\_
- c. barium \_\_\_\_\_

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

25. State the number of electrons lost or gained in forming each of these ions.  
Name the ions and tell whether it is an anion or a cation.

a.  $Mg^{2+}$  \_\_\_\_\_

c.  $Br^{-}$  \_\_\_\_\_

b.  $Ca^{2+}$  \_\_\_\_\_

d.  $Ag^{+}$  \_\_\_\_\_

26. Describe the formation of an ion from a metal and a nonmetal in terms of the octet rule.

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# 7.2

## IONIC BONDS AND IONIC COMPOUNDS

### Section Review

#### Objectives

- Explain the electrical charge of an ionic compound
- Describe three properties of ionic compounds

#### Vocabulary

- ionic compounds
- ionic bonds
- chemical formula
- formula unit
- 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 means of   1  . 1. \_\_\_\_\_

The forces of attraction that hold   2   charged ions together in 2. \_\_\_\_\_

ionic compounds are called   3  . Although they are composed 3. \_\_\_\_\_

of ions, ionic compounds are electrically   4  . The lowest whole- 4. \_\_\_\_\_

number ratio of ions in an ionic compound is called a   5  . 5. \_\_\_\_\_

Nearly all ionic compounds are solid   6   at room 6. \_\_\_\_\_

temperature. Ionic compounds in general have very   7   7. \_\_\_\_\_

melting temperatures. This is because the   8   attractive 8. \_\_\_\_\_

forces between the ions result in a very   9   structure. 9. \_\_\_\_\_

Ionic compounds conduct an electric current when in the 10. \_\_\_\_\_

  10   state or dissolved in water.

#### 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  $\text{Na}^+$  in  $\text{NaCl}$  is 6.
- \_\_\_\_\_ 14. In forming an ionic compound, an atom of an element gains electrons.
- \_\_\_\_\_ 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 compounds	a. the number of ions of opposite charge surrounding each ion in a crystal
_____ 17. ionic bonds	b. compounds composed of cations and anions
_____ 18. chemical formula	c. shows the kinds and numbers of atoms in the smallest representative unit of a substance
_____ 19. formula unit	d. lowest whole-number ratio of ions in an ionic compound
_____ 20. coordination number	e. the electrostatic 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.

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

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# 7.3 BONDING IN METALS

## Section Review

### Objectives

- Model the valence electrons of metal ions
- Describe the arrangement of atoms in a metal
- Explain the importance of alloys

### Vocabulary

- metallic bonds
- alloys

### 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 2. This arrangement constitutes the 3 **2.** \_\_\_\_\_  
 bond. The electron mobility accounts for the excellent **3.** \_\_\_\_\_  
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. Metals that are good conductors of electricity 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

- \_\_\_\_\_ 16. ductile
- \_\_\_\_\_ 17. metallic bonds
- \_\_\_\_\_ 18. alloy
- \_\_\_\_\_ 19. malleable
- \_\_\_\_\_ 20. interstitial alloy

#### Column B

- a. an alloy whose component atoms are different sizes
- b. a mixture of two or more elements, at least one of which is a metal
- c. can be hammered or forced into shapes
- d. can be drawn into wires
- 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.

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

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## 7

**IONIC AND METALLIC BONDING****Practice Problems**

*In your notebook, answer the following.*

**SECTION 7.1 IONS**

- For each element below, state (i) the number of valence electrons in the atom, (ii) the electron dot structure, and (iii) the chemical symbol(s) for the most stable ion.
  - Ba
  - I
  - K
- How many valence electrons does each of the following atoms have?
  - gallium
  - fluorine
  - selenium
- Write the electron configuration for each of the following atoms and ions.
  - Ca
  - chlorine atom
  - $\text{Na}^+$
  - phosphide ion
  - $\text{O}^{2-}$
- What is the relationship between the group number of the representative elements and the number of valence electrons?
- How many electrons will each element gain or lose in forming an ion? State whether the resulting ion is a cation or an anion.
  - strontium
  - aluminum
  - tellurium
  - rubidium
  - bromine
  - phosphorus
- Give the name and symbol of the ion formed when
  - a chlorine atom gains one electron.
  - a potassium atom loses one electron.
  - an oxygen atom gains two electrons.
  - a barium atom loses two electrons.
- How many electrons are lost or gained in forming each of the following ions?
  - $\text{Mg}^{2+}$
  - $\text{Br}^-$
  - $\text{Ag}^+$
  - $\text{Fe}^{3+}$
- Classify each of the following as a cation or an anion.
  - $\text{Na}^+$
  - $\text{Cu}^{2+}$
  - $\text{I}^-$
  - $\text{O}^{2-}$
  - $\text{Ca}^{2+}$
  - $\text{Cs}^+$