Chapter 4 Chemical Bonds

Study Guide

1. Ionic Bonds
    a. Electron Transfer
        i. **Ion**
    b. Forming an **Ionic Bond**
    c. **Polyatomic Ions**
    d. Naming Ionic Compounds
        i. *What kind of atom has a name change when it becomes an ion?*
    e. Properties of Ionic Compounds
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        iii. Electrical Conductivity
2. Covalent Bonds
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        i. **Covalent bond**
    b. How Many Bonds?
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    c. Properties of **Molecular Compounds**
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3. Crystal Chemistry
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    b. Bonding in Mineral Crystals
        i. An Ionic Crystal
        ii. A Covalent Crystal
    c. Comparing Crystals

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SECTION 4-1 **REVIEW AND REINFORCE**

Ionic Bonds

◆ Understanding Main Ideas

Answer the following questions on a separate sheet of paper.

1. How does an atom become a positive ion? How does an atom become a negative ion?
2. How do ions form electrically neutral compounds?
3. What characteristics do solid ionic compounds share?
4. How does the electrical conductivity of ionic compounds change when they are melted or dissolved in water? Why is this so?

Use the chart to answer the following questions on a separate sheet of paper.

Ions and Their Charges		
Name	**Charge**	**Symbol/Formula**
Ammonium	1+	NH_4^+
Potassium	1+	K^+
Calcium	2+	Ca^{2+}
Magnesium	2+	Mg^{2+}
Chloride	1−	Cl^-
Oxide	2−	O^{2-}
Sulfide	2−	S^{2-}
Phosphate	3−	PO_4^{3-}

5. How many potassium ions are needed to balance the charge of one sulfide ion? Explain.
6. Predict the formulas for calcium chloride and potassium phosphate.
7. Name the following compounds: MgS, NH_4Cl, and K_2O.
8. Which ions in the table are polyatomic ions?

◆ Building Vocabulary

Answer the following questions on a separate sheet of paper.

9. What is an ion?
10. What is an ionic bond?
11. How are ions in a crystal arranged?

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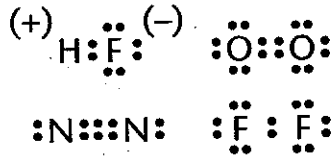
SECTION 4-2 REVIEW AND REINFORCE

Covalent Bonds

◆ Understanding Main Ideas

Answer the following questions in the spaces provided.



1. Circle all the covalent bonds in the electron dot diagrams above.
2. Which bond(s) shown are double bonds?

_____

3. Which bond(s) shown are triple bonds?

_____

4. What makes the bond in HF a polar bond?

_____

_____

5. Which molecule(s) shown have nonpolar bonds?

_____

6. How do the melting points, boiling points, and conductivity of molecular compounds compare to those of ionic compounds?

_____

_____

◆ Building Vocabulary

Complete each sentence by writing polar *or* nonpolar *in the spaces provided.*

7. A covalent bond is considered _____ if the two atoms share the electrons equally.
8. A water molecule is a _____ molecule because the oxygen atom pulls electrons closer to it than the hydrogen atoms do, forming a molecule that is slightly more positive at one end than at the other.
9. A covalent bond is considered _____ if the electrons are shared unequally.
10. A carbon dioxide molecule is a _____ molecule because the oxygen atoms are pulling with equal strength in opposite directions and cancel each other out.

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SECTION 4-3 REVIEW AND REINFORCE

Crystal Chemistry

◆ Understanding Main Ideas

Answer the following questions in the spaces provided.

1. What is a mineral?

_____

_____

2. What are some properties that mineralogists use to identify minerals?

_____

_____

3. What kinds of bonds can mineral crystals contain?

_____

4. Why do halite crystals always break into smaller crystals of the same shape?

_____

_____

Complete the chart to compare the minerals halite and quartz.

Characteristic	Halite (NaCl)	Quartz (SiO_2)
What type of bonds hold the crystal together?	ionic	**5.**
How hard is it?	**6.**	**7.**
Does it dissolve in water?	**8.**	no
What shape does it take when broken or crushed?	**9.**	**10.**

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Choose the letter of the correct answer.

1. Molecular compounds do not conduct electricity because they
   [A] do not dissolve in water. [B] do not break up into ions.
   [C] have high melting points. [D] break up into ions.

2. Why is carbon dioxide nonpolar?
   [A] The opposite pulling of its polar bonds cancel out.
   [B] Its bonds are nonpolar.
   [C] Its nonpolar bond is stronger than its polar bond.
   [D] It is an ionic compound.

3. Which is a list of mineral crystals?
   [A] sugar, sulfur, salt, methane [B] halite, water, carbon dioxide, quartz
   [C] halite, sugar, oxygen, mica [D] halite, sulfur, mica, quartz

4. An ionic bond is the attraction between
   [A] neutral ions. [B] neutral atoms.
   [C] similarly charged ions. [D] oppositely charged ions.

5. What is the chemical name for the compound with the formula Na_2S?
   [A] lithium oxide [B] magnesium sulfide [C] sodium sulfide [D] sodium fluoride

6. A covalent bond in which electrons are shared unequally is
   [A] polyatomic. [B] polar. [C] a double bond. [D] ionic.

7. Ions that are made of more than one atom are examples of
   [A] polyatomic ions. [B] negative ions. [C] positive ions. [D] neutral ions.

8. What is an ion?
   [A] an atom that doesn't have neutrons
   [B] the opposite of an electron
   [C] an atom that doesn't have protons
   [D] an atom or group of atoms that has become electrically charged

Choose the letter of the correct answer.

9. A chemical bond that forms when two atoms share electrons is called a(n)

   [A] ionic bond. [B] crystal bond. [C] polyatomic bond. [D] covalent bond.

10. When an electron is transferred from a sodium atom to a chlorine atom, the chlorine atom becomes

    [A] neutral. [B] a negative atom. [C] a negative ion. [D] a positive ion.

11. The ions in an ionic compound form regular patterns because

    [A] ions are always found in a 1:1 ratio.

    [B] each ion has a square shape.

    [C] every ion is attracted to ions near it with an opposite charge.

    [D] every ion shares an electron with the ion next to it.

Fill in the word or phrase that best completes the statement(s).

12. Three properties used to identify mineral crystals are _____.

13. When a lithium atom loses an electron, it becomes a(n) _____ charged ion.

14. Six dots between two element symbols in an electron dot diagram indicate a _____ bond.

15. A naturally occurring solid that has a crystal structure and a definite chemical composition is called a(n) _____.

16. It takes _____ calcium ion(s) (Ca^{2+}) to form an ionic bond with a carbonate ion (CO_3^{2-}).

17. Because the electrons in a molecule of hydrogen fluoride (HF) are more strongly pulled toward the fluorine atom, the molecule is _____.

18. If an aluminum ion has a charge of 3+ (Al^{3+}) and a fluorine atom has a charge of 1– (F^{1-}), the formula for aluminum fluoride must be _____.

19. A(n) _____ bond is formed when two atoms share electrons.

20. Ionic compounds that dissolve in water conduct electricity because they _____.

Fill in the word or phrase that best completes the statement(s).

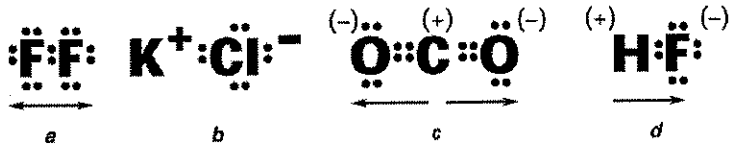
21. Molecular compounds that dissolve in water do not conduct electricity because no _____ are present.

If the statement is true, write true. If it is false, change the underlined word or words to make the statement true.

22. Orderly crystal shapes, high melting points, and electrical conductivity when dissolved in water are properties of <u>ionic</u> compounds.

23. A <u>single</u> covalent bond forms when two pairs of electrons are shared between two atoms.

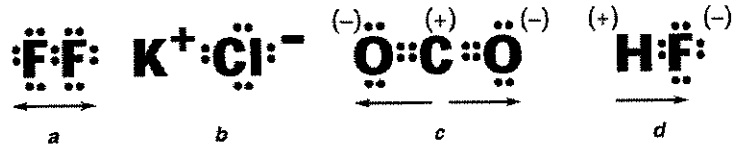
Use the diagram to answer the question(s).



24. Explain what the minus (–) and plus (+) signs in diagrams c and d show.

25. In diagram b, what do the symbols K^+ and Cl^- represent?

Use the diagram to answer the question(s).



26. Which diagram shows atoms bonded by double bonds?

27. Identify the diagram(s) that show(s) a molecule having one or more polar covalent bonds. For each diagram you name, tell whether the molecule is polar or nonpolar.

Use the table to answer the question(s).

Characteristics of Unknown Compounds				
Compound	Melting Point (°C)	Boiling Point (°C)	Conducts Electricity?	Dissolves in Water?
A	–23	76.8	No	No
B	801	1413	Yes, in water	Yes
C	185–186	Decomposes	No	Yes
D	–182	–164	No	No
E	681	1323	Yes, in water	Yes

28. Explain how attractions between molecules could cause compound D to have a lower melting point than compound A.

Write an answer to the following question(s).

29. A characteristic property of ionic compounds is electrical conductivity. Yet a solid salt crystal does not conduct electricity. Explain.

30. Explain what is meant by the term "polar bond."