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CHAPTER 7 STUDY GUIDE

Ionic Compounds and Metals

Section 7.1 Ion Formation

In your textbook, read about chemical bonds and formation of ions.

Use each of the terms below just once to complete the passage.

chemical bond	electrons	energy level	ions	noble gases
nucleus	octet	pseudo-noble gas formations		valence

The force that holds two atoms together is called a(n) **(1)** Chemical Bond Such an attachment may form by the attraction of the positively charged **(2)** nucleus of one atom for the negatively charged **(3)** electrons of another atom, or by the attraction of charged atoms, which are called **(4)** ions. The attractions may also involve **(5)** valence electrons, which are the electrons in the outermost **(6)** energy level. The **(7)** noble gases are a family of elements that have very little tendency to react. Most of these elements have a set of eight outermost electrons, which is called a stable **(8)** octet. The relatively stable electron structures developed by loss of electrons in certain elements of groups 3, 4, 13, and 14 are called **(9)** pseudo-noble gas formations

For each statement below, write *true* or *false*.

F **10.** A positively charged ion is called an anion.

T **11.** Elements in group 1 lose their one valence electron, forming an ion with a 1+ charge.

F **12.** Elements tend to react so that they acquire the electron structure of a halogen.

T **13.** A sodium atom tends to lose one electron when it reacts.

T **14.** The electron structure of a zinc ion (Zn^{2+}) is an example of a pseudo-noble gas formation.

F **15.** A Cl^- ion is an example of a cation.

T **16.** The ending *-ide* is used to designate an anion.

F **17.** Nonmetals form a stable outer electron configuration by losing electrons and becoming anions.

Section 7.2 Ionic Bonds and Ionic Compounds

In your textbook, read about forming ionic bonds and the characteristics of ionic compounds.

Circle the letter of the choice that best completes the statement or answers the question.

1. An ionic bond is
- **a.** attraction of an atom for its electrons.
- **b.** attraction of atoms for electrons they share.
- **c.** a force that holds together atoms that are oppositely charged.
- **d.** the movement of electrons from one atom to another.

2. The formula unit of an ionic compound shows the
- **a.** total number of each kind of ion in a sample.
- **b.** simplest ratio of the ions.
- **c.** numbers of atoms within each molecule.
- **d.** number of nearest neighboring ions surrounding each kind of ion.

3. The overall charge of a formula unit for an ionic compound
- **a.** is always zero.
- **b.** is always negative.
- **c.** is always positive.
- **d.** may have any value.

4. How many chloride (Cl^-) ions are present in a formula unit of magnesium chloride, given that the charge on a Mg ion is 2+?

a. one-half **b.** one **c.** two **d.** four

5. Ionic bonds generally occur between
- **a.** metals.
- **b.** nonmetals.
- **c.** a metal and a nonmetal.
- **d.** noble gases.

6. Salts are examples of

a. nonionic compounds. **b.** metals. **c.** nonmetals. **d.** ionic compounds.

7. A three-dimensional arrangement of particles in an ionic solid is called a(n)

a. crystal lattice. **b.** sea of electrons. **c.** formula unit. **d.** electrolyte.

8. In a crystal lattice of an ionic compound,
- **a.** ions of a given charge are clustered together, far from ions of the opposite charge.
- **b.** ions are surrounded by ions of the opposite charge.
- **c.** a sea of electrons surrounds the ions.
- **d.** neutral molecules are present.

Section 7.2 ***continued***

9. What is the relationship between lattice energy and the strength of the attractive force holding ions in place?

a. The more positive the lattice energy is, the greater the force.

b. The more negative the lattice energy is, the greater the force.

c. The closer the lattice energy is to zero, the greater the force.

d. There is no relationship between the two quantities.

10. The formation of a stable ionic compound from ions

a. is always exothermic.

b. may be either exothermic or endothermic.

c. is always endothermic.

d. neither absorbs nor releases energy.

11. In electron transfer involving a metallic atom and a nonmetallic atom during ion formation, which of the following is correct?

a. The metallic atom gains electrons from the nonmetallic atom.

b. The nonmetallic atom gains electrons from the metallic atom.

c. Both atoms gain electrons.

d. Neither atom gains electrons.

Underline the word that correctly describes each property in ionic compounds.

12. Melting point	Low	High
13. Boiling point	Low	High
14. Hardness	Hard	Soft
15. Brittleness	Flexible	Brittle
16. Electrical conductivity in the solid state	Good	Poor
17. Electrical conductivity in the liquid state	Good	Poor
18. Electrical conductivity when dissolved in water	Good	Poor

For each statement below, write *true* or *false*.

T **19.** The crystal lattice of ionic compounds affects their melting and boiling points.

T **20.** The lattice energy is the energy required to separate the ions of an ionic compound.

F **21.** The energy of an ionic compound is higher than that of the separate elements that formed it.

F **22.** Large ions tend to produce a more negative value for lattice energy than smaller ions do.

T **23.** Ions that have larger charges tend to produce a more negative lattice energy than ions with smaller charges do.

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Section 7.3 Names and Formulas for Ionic Compounds

In your textbook, read about communicating what is in a compound and naming ions and ionic compounds.

Use each of the terms below just once to complete the passage.

anion	*-ate*	cation	electrons	zero
lower right	monatomic	one	oxidation number	*-ite*
oxyanion	polyatomic	subscript		

A one-atom ion is called a(n) **(1)** monatomic ion. The charge of such an ion is equal to the atom's **(2)** oxidation number, which is the number of **(3)** electrons transferred to or from the atom to form the ion. In ionic compounds, the sum of the charges of all the ions equals **(4)** zero. Ions made up of more than one atom are called **(5)** polyatomic ions. If such an ion is negatively charged and includes one or more oxygen atoms, it is called a(n) **(6)** oxyanion. If two such ions can be formed that contain different numbers of oxygen atoms, the name for the ion with more oxygen atoms ends with the suffix **(7)** -ate. The name for the ion with fewer oxygen atoms ends with **(8)** -ite.

In the chemical formula for any ionic compound, the chemical symbol for the **(9)** cation is written first, followed by the chemical symbol for the **(10)** anion. A(n) **(11)** subscript is a small number used to represent the number of ions of a given element in a chemical formula. Such numbers are written to the **(12)** lower right of the symbol for the element. If no number appears, the assumption is that the number equals **(13)** one.

For each formula in Column A, write the letter of the matching name in Column B.

Column A	Column B
e **14.** ClO_2^-	**a.** chlorate
D **15.** ClO_4^-	**b.** hypochlorite
B **16.** ClO^-	**c.** chloride
C **17.** Cl^-	**d.** perchlorate
A **18.** ClO_3^-	**e.** chlorite

Section 7.3 *continued*

For each of the following chemical formulas, write the correct name of the ionic compound represented. You may refer to the periodic table on pages 156–157 and Table 8.7 for help.

19. NaI Sodium Iodide
20. $CaCl_2$ Calcium chloride
21. K_2S Potassium Sulfide
22. MgO Magnesium Oxide
23. $LiHSO_4$ Lithium Hydrogen sulfate (bisulfate)
24. NH_4Br Ammonium Bromide
25. Ca_3N_2 Calcium nitride
26. Cs_3P Cesium phosphide
27. $KBrO_3$ Potassium bromate
28. $Mg(ClO)_2$ magnesium hypochlorite
29. Li_2O_2 Lithium Oxide
30. $Be_3(PO_4)_2$ Beryllium Phosphate
31. $(NH_4)_2CO_3$ Ammonium Carbonate
32. $NaBrO_3$ Sodium bromate
33. Fe_2O_3 Iron III oxide
34. $Fe(IO_3)_2$ Iron II iodate

For each of the following ionic compounds, write the correct formula for the compound. You may refer to the periodic table on pages 156–157 and Table 8.7 for help.

35. beryllium nitride Be_3N_2
36. nickel(II) chloride $NiCl_2$
37. potassium chlorite $KClO_2$
38. copper(I) oxide Cu_2O
39. magnesium sulfite $MgSO_3$
40. ammonium sulfide $(NH_4)_2S$
41. calcium iodate $Ca(IO_3)_2$
42. iron(III) perchlorate $Fe(ClO_4)_3$
43. sodium nitride Na_3N

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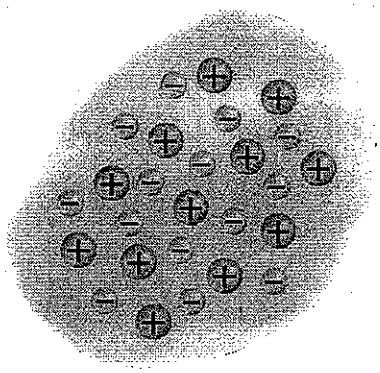
Section 7.4 Metallic Bonds and the Properties of Metals

In your textbook, read about metallic bonds.

Use the diagram of metallic bonding to answer the following questions.



1. What is the name of the model of metallic bonding that is illustrated?
   electron sea model
2. Why are the electrons in a metallic solid described as delocalized?
   They are free to move from 1 atom to another
3. Which electrons from the metal make up the delocalized electrons?
   Valence electrons
4. Are the metal atoms that are shown cations or anions? How can you tell?
   Cations: They are positively charged
5. How do the metallic ions differ from the ions that exist in ionic solids?
   The electrons are not completely lost by the metal atoms, as they are in an ionic solid
6. Explain what holds the metal atoms together in the solid.
   They are bonded by the oppositely charged electron sea that surrounds them.

In your textbook, read about the properties of metals.

For each property, write *yes* if the property is characteristic of most metals, or *no* if it is not. If the property is a characteristic of metals, explain how metallic bonding accounts for the property.

7. Malleable Yes: when the metal is hammered, the delocalized electrons move, keeping the metallic bonds intact
8. Brittle NO
9. Lustrous Yes: the delocalized electrons move, absorb & release proton
10. High melting point Yes: the metallic bonds are strong
11. Low boiling point NO
12. Ductile Yes, when the metal is pulled, the delocalized electrons move, keeping the metallic Bonds intact
13. Poor conduction of heat NO
14. Good conduction of electricity Yes: delocalized electrons are mobile