Ionic Compounds

Section 8.1 Forming Chemical Bonds
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
- 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 1B, 2B, 3A, and 4A
are called (9) **pseudo-noble gas configurations**.

For each statement below, write true or false.

10. A positively charged ion is called an anion. **false**
11. Elements in group 1A lose their one valence electron, forming an ion with
   a 1+ charge. **true**
12. Elements tend to react so that they acquire the electron structure of a
   halogen. **false**
13. A sodium atom tends to lose one electron when it reacts. **true**
14. The electron structure of a zinc ion (Zn^{2+}) is an example of a pseudo-
   noble gas formation. **false**
15. A Cl^{-} ion is an example of a cation. **true**
16. The ending -ide is used to designate an anion. **true**
17. Nonmetals form a stable outer electron configuration by losing electrons
   and becoming anions. **true**
Section 8.2 What is an ionic bond?
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 8.2 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. Don't need to know.

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

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

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

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

23. Ions that have larger charges tend to produce a more negative lattice energy than ions with smaller charges do.
Section 8.3 Chemical Formulas and Their Names

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
- monatomic
- cation
- polyatomic
- electrons
- subscript
- oxidation number
- zero
- -ate
- -ite

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** #, 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.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>a. chlorate</td>
</tr>
<tr>
<td>D</td>
<td>b. hypochlorite</td>
</tr>
<tr>
<td>B</td>
<td>c. chloride</td>
</tr>
<tr>
<td>C</td>
<td>d. perchlorate</td>
</tr>
<tr>
<td>A</td>
<td>e. chlorite</td>
</tr>
</tbody>
</table>
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. CaCl₂  calcium chloride
21. K₂S  potassium sulfide
22. MgO  magnesium oxide
23. LiHSO₄  lithium bisulfate
24. NH₄Br  ammonium bromide
25. Ca₃N₂  calcium nitride
26. Cs₃P  cesium phosphide
27. KBrO₃  potassium bromate
28. Mg(ClO)₂  magnesium hypochlorite
29. Li₂O₂  lithium peroxide
30. Be₃(PO₄)₂  beryllium phosphate
31. (NH₄)₂CO₃  ammonium carbonate
32. NaBrO₃  sodium bromate
33. Fe₂O₃  iron (III) oxide
34. Fe(IO₃)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  Be₃N₂
36. nickel(II) chloride  NiCl₂
37. potassium chlorite  KClO₂
38. copper(I) oxide  Cu₂O
39. magnesium sulfite  MgSO₃
40. ammonium sulfide  (NH₄)₂S
41. calcium iodate  Ca(IO₃)₂
42. iron(III) perchlorate  Fe(ClO₄)₃
43. sodium nitride  Na₃N
Section 8.4 Metallic Bonds and 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 aren't attached to one atom

3. Which electrons from the metal make up the delocalized electrons?
   - valence e-

4. Are the metal atoms that are shown cations or anions? How can you tell?
   - cations; + nucleus

5. How do the metallic ions differ from the ions that exist in ionic solids?
   - not in rigid crystal lattice structure containing anions & cations

6. Explain what holds the metal atoms together in the solid.
   - structure of nuclei & constant movement of delocalized valence e-

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
   - easy to shift due to lack of rigid crystal lattice

8. Brittle  no

9. Lustrous  yes $\Rightarrow$ shiny!

10. High melting point  yes

11. Low boiling point  no

12. Ductile  yes $\Rightarrow$ same deal as malleability

13. Poor conduction of heat  no

14. Good conduction of electricity  yes $\Rightarrow$ free moving electrons