

## Activity 10: Ionic Compounds

### *Learning Objectives*

- Part 1      *Predict the ionic charge of a main-group element*  
*Predict the number of valence electrons from the periodic table for a main-group element*
- Part 2      *Name ionic compounds given the formula*  
*Write the formula for ionic compounds given the name*
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**Estimated Completion Time**      30–45 Minutes

### **Instructor Information**

The ability to identify the number of valence electrons is necessary for students to later understand covalent bonding and the octet rule. For this reason, the number of valence electrons for the main-group elements is noted as a number from 1 to 8, even though some of the heavier elements have more than eight valence electrons. In terms of covalent bonding, the octet rule still applies for bonding of, for example, the halogens.

### **ANSWERS TO QUESTIONS**

#### **Part 1. Ion Formation**

1. The group number is the number of valence electrons for the main-group elements.
2. a. 7      b. 8      c. 2      d. 8      e. 8      f. 8      g. 8
3. They are all in the same group on the periodic table
4. The sodium atom gave up one electron to become a 1+ ion.
5. The oxygen atom took on two valence electrons to become a 2– ion.

6. a.  $\text{Na}^+$   
b.  $\text{O}^{2-}$
7. a.  $\text{H}^+$  has one proton and zero electrons;  $\text{H}^-$  has one proton and two electrons.  
b. Because most isotopes of hydrogen have a mass of 1, they contain only one particle that contributes to the mass, which must be a proton to be hydrogen. An  $\text{H}^+$  does not contain an electron, so it contains only one proton; the two are equivalent ( $\text{H}^+ = \text{proton}$ ).
8. The Group 8A elements are called “inert” because they are stable as atoms. There is stability in obtaining a full valence shell of an atom since the atoms in the main group form ions by giving and taking electrons to form a full valence shell.

#### Activity 10: Skill Development—Ion Formation

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1. a. 6              b. 7              c. 1              d. 3
2. a. gain 2e      b. gain 1e      c. lose 1e      d. lose 3e
3. a. 5              b. 2              c. 6              d. 7
4. a. gain 3e      b. lose 2e      c. gain 2e      d. gain 1e
5. a. Fewer  
b. Valence  
c. Positive
6. a. Protons  
b. Cation  
c. Sulfide

## Part 2. Ionic Compounds

1. The metal goes first. The cation goes first.
2. Anions and cations arise from an unequal number of protons and electrons in an element. Anions have more electrons than protons; cations have more protons than electrons.
3. a.  $1+$ ,  $2-$   
b. The total charge on the ionic compound is neutral. For this to occur, there must be two potassium ions (charge  $1+$  each) combined with each sulfide ( $2-$  charge each).
4. The names with the Roman numerals contain transition metals. The names without contain main-group metals.
5. a.  $3+$       b.  $2+$
6. a. The Roman numeral represents the charge on the transition metal ion.  
b. The Roman numeral is used when a transition metal with a varying charge is in an ionic compound.
7. The nonmetal suffix is changed to *-ide*.

<b><u>Formula</u></b>	<b><u>Name</u></b>
KCl	<b><u>Potassium chloride</u></b>
<b><u>Na<sub>2</sub>SO<sub>4</sub></u></b>	Sodium sulfate
Fe(OH) <sub>3</sub>	<b><u>Iron(III) hydroxide</u></b>
NaHCO <sub>3</sub>	<b><u>Sodium bicarbonate</u></b>
<b><u>NH<sub>4</sub>NO<sub>3</sub></u></b>	Ammonium nitrate
<b><u>AgC<sub>2</sub>H<sub>3</sub>O<sub>2</sub></u></b>	Silver acetate
CaHPO <sub>4</sub>	<b><u>Calcium hydrogen phosphate</u></b>
<b><u>HgCl<sub>2</sub></u></b>	Mercury(II) chloride
<b><u>Al<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub></u></b>	Aluminum carbonate

### Activity 10: Skill Development—Ionic Compounds

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1.

Elements		Compound Formula	Compound Name
$\text{Mg}^{2+}$	$\text{Br}^-$	<b><math>\text{MgBr}_2</math></b>	<b>Magnesium bromide</b>
$\text{Na}^+$	$\text{O}^{2-}$	<b><math>\text{Na}_2\text{O}</math></b>	<b>Sodium oxide</b>
$\text{Al}^{3+}$	$\text{NO}_3^-$	<b><math>\text{Al}(\text{NO}_3)_3</math></b>	<b>Aluminum nitrate</b>
$\text{Cu}^+$	$\text{CO}_3^{2-}$	<b><math>\text{Cu}_2\text{CO}_3</math></b>	<b>Copper (I) carbonate</b>
$\text{Zn}^{2+}$	$\text{F}^-$	<b><math>\text{ZnF}_2</math></b>	<b>Zinc fluoride</b>
$\text{Co}^{2+}$	$\text{S}^{2-}$	<b><math>\text{CoS}</math></b>	<b>Cobalt (II) sulfide</b>
$\text{Ca}^{2+}$	$\text{I}^-$	<b><math>\text{CaI}_2</math></b>	<b>Calcium iodide</b>

2. Sodium chloride                       $\text{NaCl}$   
Sodium lactate                         $\text{NaC}_3\text{H}_5\text{O}_3$   
Potassium chloride                    $\text{KCl}$   
Calcium chloride                        $\text{CaCl}_2$   
Sodium hydroxide                       $\text{NaOH}$   
Hydrogen chloride                       $\text{HCl}$

(Hydrogen chloride is actually a covalent compound. When  $\text{HCl}$  is mixed with water, it forms the ionic hydrochloric acid.)

3. a.  $\text{Li}_2\text{CO}_3$       b.  $\text{KMnO}_4$               c.  $\text{NaI}$