3.10: Nomenclature of Ionic Compounds

The simplest ionic compounds consist of a single type of cation associated with a single type of anion. Nomenclature for these compounds is trivial; the cation is named first, followed by the anion. If the anion is a single element, the suffix *ide* is added to the root name of the element.

When you are constructing names for ionic compounds, you do not use “multipliers” to indicate how many cations or anions are present in the compound. For example NaI is named *sodium iodide;* Na_2S is named *sodium sulfide;* $CaCl_2$ is named *calcium chloride.* The chemist reading the name is assumed to have sufficient knowledge to pair the elements properly based on their common valence states. There are exceptions to this simple nomenclature, however. Many transition metals exist as more than one type of cation. Thus, iron exists as Fe^{2+} and Fe^{3+} cations (they are referred to as “oxidation states”, and will be covered in detail in Chapter 5). When you are naming an ionic compound containing iron, it is necessary to indicate which oxidation state the metal has. For metals, the oxidation state is the same as the charge. Thus Fe^{2+} in a compound with chloride would have a formula $FeCl_2$ and would be named iron (II) chloride, with the oxidation state (the charge on the iron) appearing as a Roman numeral in parenthesis after the cation. The cation Fe^{3+} paired with oxygen would have the formula Fe_2O_3 and would have the name iron (III) oxide.

The procedure for naming ionic compounds contain polyatomic ions is identical to that described above for simple ions. Thus, $CaCO_3$ is named *calcium carbonate;* Na_2SO_4 is named *sodium sulfate;* $(NH_4)_2HPO_4$ (a compound with two polyatomic ions) is named *ammonium hydrogen phosphate;* and Pb^{2+} paired with SO_4^{2-}, $PbSO_4$ is named *lead (II) sulfate.*

✔ Example 3.10.1:

Write a correct chemical formula for each of the following ionic compounds:

a. Calcium bromide
b. Aluminum oxide
c. Copper (II) chloride
d. Iron (III) oxide

Solution

a. Calcium is 2+, bromide is 1-; $CaBr_2$.
b. Aluminum is 3+, oxide is 2-; Al_2O_3.
c. From the oxidation state that is given, copper is 2+, chloride is 1-; $CuCl_2$.
d. From the oxidation state, iron is 3+, oxide is 2-; Fe_2O_3.

✔ Example 3.10.1:

Write a proper chemical name for each of the following ionic compounds:

a. Li_2S
b. CaO
c. $NiCl_2$
d. FeO

Solution

a. We don’t use multipliers, so this is simply lithium sulfide.
b. This is simply calcium oxide.
c. We don’t have to specify an oxidation state for nickel, so this is nickel chloride.
d. We must specify that iron is 2+ in this compound; iron (II) oxide.

? Exercise 3.10.1

Write a correct chemical formula for each of the following ionic compounds:

a. Sodium phosphide
b. Iron (II) nitrite

c. Calcium hydrogen phosphate
d. Chromium (III) oxide

? Exercise 3.10.1

Write a proper chemical name for each of the following ionic compounds:

a. NaBr
b. $CuCl_2$
c. $Fe(NO_3)_3$
d. $(NH_4)_3PO_4$