5.1.9: Naming Ionic Compounds

Learning Objectives

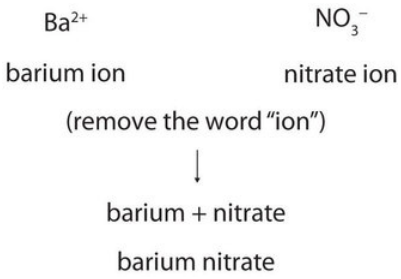
- Write the names for ionic compounds by recognizing and naming the ions in the formula unit.

Ionic compounds are named using the formula unit and by following some important conventions. First, the name of the cation is written *first* followed by the name of the anion. Because most metals form cations and most nonmetals form anions, formulas typically list the metal first and then the nonmetal. Second, charges are *not* included in the name (or the formula). Remember that in an ionic compound, the component species are ions, not neutral atoms, even though the formula does not contain charges. The proper formula for an ionic compound will show how many of each ion is needed to balance the total positive and negative charges; the name does not need to include indication of this ratio.

There are two main types of ionic compound with different naming rules for each; Type I: compounds containing cations of main group elements and Type II: compounds containing cations of variable charge (generally transition metals). Below we will look at examples of each type to learn the rules for naming.

Type I Ionic Compounds

Cations of main group elements do not have variable charges and are the simply named by placing the name of the cation first, followed by the name of the anion, and dropping the word *ion* from both parts. For example, what is the name of the compound whose formula is $\mathrm{Ba(NO_3)_2}$?



The compound's name does not need to indicate that there are two nitrate ions for every barium ion. You must determine the ratio of ions in the formula unit by balancing the positive and negative charges.

Type II Ionic Compounds

Some metals can form cations with variable charges. When naming a formula for an ionic compound whose cation can have more than one possible charge, you must first determine the charge on the cation before identifying its correct name. For example, consider $\mathrm{FeCl_2}$ and $\mathrm{FeCl_3}$. In the first compound, the iron ion has a 2+ charge because there are two $\mathrm{Cl^-}$ ions in the formula (1− charge on each chloride ion). In the second compound, the iron ion has a 3+ charge, as indicated by the three $\mathrm{Cl^-}$ ions in the formula. These are two different compounds that need two different names. By the *stock system*, the names are iron(II) chloride and iron(III) chloride. If we were to use the stems and suffixes of the *common system*, the names would be ferrous chloride and ferric chloride, respectively.

Ionic Compounds in Your Cabinets

Every day you encounter and use a large number of ionic compounds. Some of these compounds, where they are found, and what they are used for are listed in Table 5.1.9.1. Look at the label or ingredients list on the various products that you use during the next few days, and see if you run into any of those in this table, or find other ionic compounds that you could now name or write as a formula.

Table 5.1.9.1: Everyday Ionic Compounds

Ionic Compound	Name	Use
NaCl	sodium chloride	ordinary table salt

KI	potassium iodide	added to “iodized” salt for thyroid health
NaF	sodium fluoride	ingredient in toothpaste
$NaHCO_3$	sodium bicarbonate	baking soda; used in cooking (and in antacids)
Na_2CO_3	sodium carbonate	washing soda; used in cleaning agents
NaOCl	sodium hypochlorite	active ingredient in household bleach
$CaCO_3$	calcium carbonate	ingredient in antacids
$Mg(OH)_2$	magnesium hydroxide	ingredient in antacids
$Al(OH)_3$	aluminum hydroxide	ingredient in antacids
NaOH	sodium hydroxide	lye; used as drain cleaner
K_3PO_4	potassium phosphate	food additive (many purposes)
$MgSO_4$	magnesium sulfate	added to purified water
Na_2HPO_4	sodium hydrogen phosphate	anti-caking agent; used in powdered products
Na_2SO_3	sodium sulfite	preservative

As you practice naming compounds, use Figure 5.1.9.1as a guide.

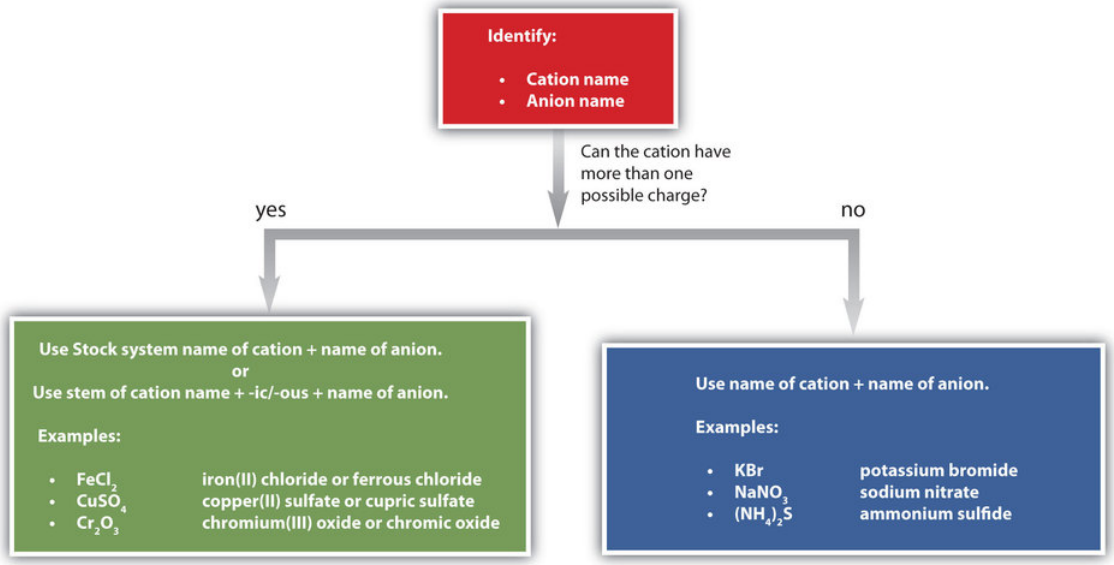


Figure 5.1.9.1: A Guide to Naming Simple Ionic Compounds. Follow these steps to name a simple ionic compound.

Identify the cation name and the anion name. If the cation can have more than one possible charge, either use the Stock system name of the cation and name of the anion, or use the stem of the cation name and -ic/-ous and the name of the anion. Examples of this would be FeCl2, which is iron(II) chloride of ferrous chloride, CuSO4, which is copper(II) sulfate or cupric sulfate, and Cr2O3, which is chromium(III) oxide or chromic oxide. If the cation can not have more than one possible charge, use the name of the cation and the name of the anion. Examples of this would be KBr, which is potassium bromide, NaNO3, which is sodium nitrate, and (NH4)2S, which is ammonium sulfide.

Example 5.1.9.3

Name each ionic compound, using both Stock and common systems if necessary.

a. $Ca_3(PO_4)_2$
b. $(NH_4)_2Cr_2O_7$

c. KCl
d. CuCl
e. SnF_2

Answer a

calcium phosphate

Answer b

ammonium dichromate (the prefix *di-* is part of the name of the anion)

Answer c

potassium chloride

Answer d

copper(I) chloride or cuprous chloride

Answer e

tin(II) fluoride or stannous fluoride

? Exercise 5.1.9.3

Name each ionic compound, using both Stock and common systems if necessary.

a. $ZnBr_2$
b. $Fe(NO_3)_3$
c. Al_2O_3
d. CuF_2
e. AgF

Answer a

zinc bromide

Answer b

iron (III) nitrate or ferric nitrate

Answer c

aluminum oxide

Answer d

copper (II) fluoride or cupric fluoride

Answer e

silver fluoride
