

## Naming Ionic Compounds

### Ionic Naming Notes

ionic compounds consist of cations (positive ions) and anions (negative ions) held together by electrostatic attraction – usually metal + nonmetal(s). They are made of monatomic ions, polyatomic ions, and/or both:

- monatomic ions which consist of a single atom
- polyatomic ions consist of more than one atom.

#### NAMING MONATOMIC CATIONS:

Metal atoms lose valence electrons to form positively charged ions, called **cations**.

An ion formed from an individual atom is a **monatomic** (or monoatomic) **cation**.

- I. Groups IA to IIIA elements silver (Ag), zinc (Zn) and cadmium (Cd) form only one type of ion each:
  - Group IA elements form +1 ions:  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$
  - Group IIA elements form +2 ions:  $\text{Be}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{Ca}^{+2}$ ,  $\text{Sr}^{+2}$ ,  $\text{Ba}^{+2}$
  - Group IIIA elements form +3 ions:  $\text{Al}^{+3}$
  - silver ion =  $\text{Ag}^+$ ; zinc ion =  $\text{Zn}^{+2}$ ; cadmium ion =  $\text{Cd}^{+2}$

When a Group IA–IIIA element, silver, zinc, or cadmium forms an ion, it is named:

#### element name + ion

e.g.  $\text{Na}^+$  = sodium ion       $\text{Sr}^{+2}$  = strontium ion       $\text{Zn}^{+2}$  = zinc ion

- II. The **Stock system** is used to name transition metals and other metals that form more than one ion:

- iron (Fe) forms two ions:  $\text{Fe}^{+2}$  and  $\text{Fe}^{+3}$
- lead (Pb) forms two ions:  $\text{Pb}^{+2}$  and  $\text{Pb}^{+4}$

When a a metal can form more than one ion, each ion is named:

#### element name (charge in Roman numerals) + ion

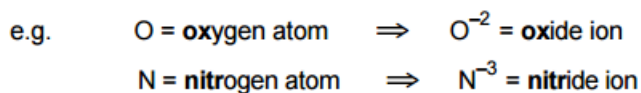
e.g.  $\text{Fe}^{+2}$  = iron (II) ion       $\text{Pb}^{+2}$  = lead (II) ion       $\text{Cu}^+$  = copper (I) ion  
 $\text{Fe}^{+3}$  = iron (III) ion       $\text{Pb}^{+4}$  = lead (IV) ion       $\text{Cu}^{+2}$  = copper (II) ion

## NAMING MONATOMIC ANIONS:

Nonmetal atoms gain valence electrons to form *negatively charged ions* called **anions**.

When a nonmetal forms an ion, it is named:

**element stem name + "ide" + ion**



## NAMING POLYATOMIC IONS:

Ions made up of more than one atom are **polyatomic ions**:

- only one polyatomic cation:  $NH_4^+$  = ammonium ion
- many polyatomic anions: see table below

$NH_4^+$  = ammonium ion

### Polyatomic Ions

$OH^-$  = hydroxide ion

$NO_2^-$  = nitrite ion

$C_2H_3O_2^-$  = acetate ion

$CN^-$  = cyanide ion

$NO_3^-$  = nitrate ion

$PO_4^{3-}$  = phosphate ion

$CrO_4^{2-}$  = chromate ion

$SO_4^{2-}$  = sulfate ion

$MnO_4^-$  = permanganate ion

$Cr_2O_7^{2-}$  = dichromate ion

$SO_3^{2-}$  = sulfite ion

$CO_3^{2-}$  = carbonate ion

$HCO_3^-$  = hydrogen carbonate ion or bicarbonate ion

For more examples of how to name ionic compounds with transition metals, pull your work from your notes. Additional examples can be viewed in this tutorial.

<https://www.youtube.com/watch?v=Rq0A-AHdB74>

<https://www.youtube.com/watch?v=8KSWRy2MMyM>

For more examples of how to name any ionic compound, including transition metals and polyatomic ions, pull your work from your notes. Additional examples can be viewed in this tutorial.

<https://www.youtube.com/watch?v=NWE4LYkG3po>

## Multiple Choice

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

- In order for ionic bonding to occur, at least one atom has to give away an electron and at least one atom has to receive an electron. Which type of elements are involved in ionic bonding?
  - noble gases
  - metals only
  - nonmetals only
  - metals and nonmetals
- Name the following chemical compound:  $K_3N$ 
  - tripotassium nitride
  - tripotassium mononitride
  - potassium nitride
  - potassium nitrate
- Name the following chemical compound:  $NaBr$ 
  - naproxen bromine
  - naproxen bromide
  - sodium bromide
  - sodium bromine

## Common Polyatomic Ions

$NH_4^+$	ammonium	$NO_3^-$	nitrate
$Hg_2^{2+}$	mercury(I)	$SO_4^{2-}$	sulfate
		$CO_3^{2-}$	carbonate
$CN^-$	cyanide	$PO_4^{3-}$	phosphate
$OH^-$	hydroxide	$ClO_3^-$	chlorate
$O_2^{2-}$	peroxide	$MnO_4^-$	permanganate
$C_2H_3O_2^-$	acetate	$Cr_2O_7^{2-}$	dichromate
$C_2O_4^{2-}$	oxalate		

- Use the table of polyatomic ions and a periodic table, select the name that corresponds to  $K_2CO_3$ .
  - phosphorus chromate
  - phosphorus carbonate
  - potassium chromate
  - potassium carbonate
- Use the table of polyatomic ions and a periodic table, choose the correct name for this compound:  $PbSO_4$ 
  - lead (II) sulfate
  - lead (I) sulfate
  - lead (I) sulfite
  - lead (II) sulfite
- Which of the following is an example of a polyatomic ion?
  - $Cs^{+1}$
  - $O^{-2}$
  - $(SO_4)^{-2}$
  - $Na^{+1}$
- Choose the correct name for the following chemical compound:  $FeO$

- a. iron oxygen  
b. iron (I) oxide
- c. iron (II) oxide  
d. iron (III) oxide
8. Choose the correct name for the following chemical compound: AgCl
- a. silver chromate  
b. silver chloride
- c. gold chloride  
d. silver cyanide
9. Choose the correct name for the following chemical compound:  $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$
- a. calcium acetate  
b. carbon acetate
- c. calcium oxalate  
d. carbon oxalate
10. Choose the correct name for the following chemical compound:  $\text{Mg}(\text{OH})_2$
- a. manganese oxide  
b. magnesium oxide
- c. manganese hydroxide  
d. magnesium hydroxide
11. Choose the correct name for the following chemical compound:  $\text{Na}_2\text{SO}_4$
- a. nitrogen sulfate  
b. sulfur sulfate
- c. sodium sulfate  
d. nitrogen sulfide
12. Choose the correct name for the following chemical compound:  $\text{Cu}(\text{NO}_3)_2$
- a. copper I nitrate  
b. copper II nitrate
- c. carbon nitrate  
d. carbon II nitrite
13. Choose the correct name for the following chemical compound:  $\text{Mg}(\text{ClO}_3)_2$
- a. magnesium chlorate  
b. manganese chlorate
- c. magnesium chloride  
d. manganese chloride
14. Choose the correct name for the following chemical compound: NaCN
- a. nitrogen cyanide  
b. nitrogen chloride
- c. sodium chloride  
d. sodium cyanide
15. Choose the correct name for the following chemical compound:  $(\text{NH}_4)_2\text{SO}_4$
- a. nitrogen sulfate  
b. nitrogen sulfide
- c. ammonium sulfate  
d. ammonium sulfide