

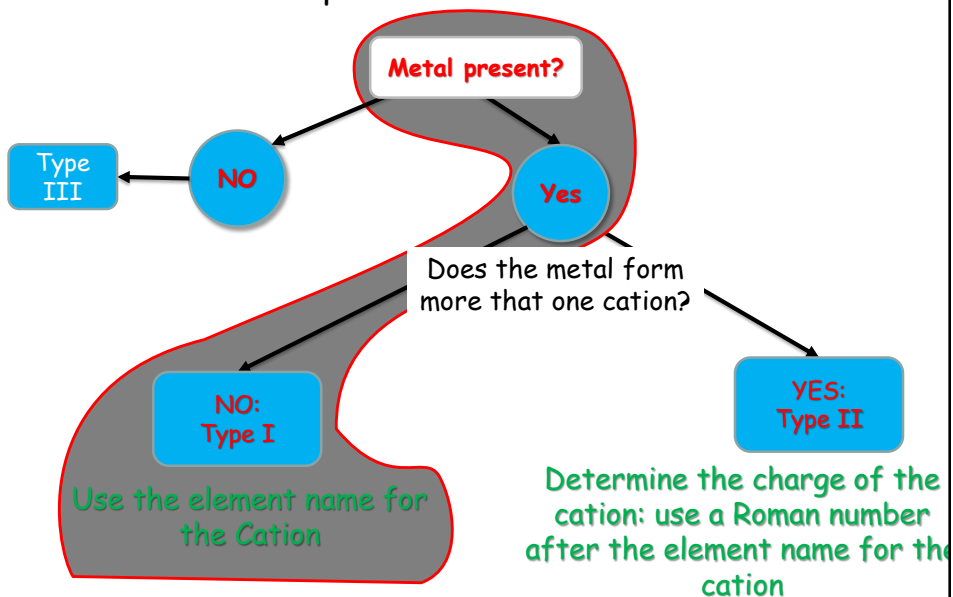
Nomenclature

Naming chemical compounds

1

Binary Compounds

Composed of two elements



Naming Ionic Binary Compounds

name of
cation
(metal)

base name of
anion (nonmetal)
+ *-ide*

© 2011 Pearson Education, Inc.

Binary Ionic Compounds (Type I)

- Shown are the elements on the periodic table and their common charges.

	1 IA	2 IIA		3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
2	Li ⁺																		
3	Na ⁺	Mg ²⁺												Al ³⁺		N ³⁻	O ²⁻	F ⁻	
4	K ⁺	Ca ²⁺					Cr ³⁺	Mn ²⁺	Fe ³⁺	Co ³⁺	Ni ²⁺	Cu ²⁺	Zn ²⁺			P ³⁻	S ²⁻	Cl ⁻	
5		Sc ³⁺										Ag ⁺	Cd ²⁺					Br ⁻	
6		Ba ²⁺											Hg ²⁺					I ⁻	

Binary Ionic Compounds (Type I)

- Examples:

KCl Potassium chlor**ide**

$MgBr_2$ Magnesium brom**ide**

CaO Calcium ox**ide**

Binary Ionic Compounds (Type I)

- Examples:

Lithium nitride

Li_3N

Aluminum oxide

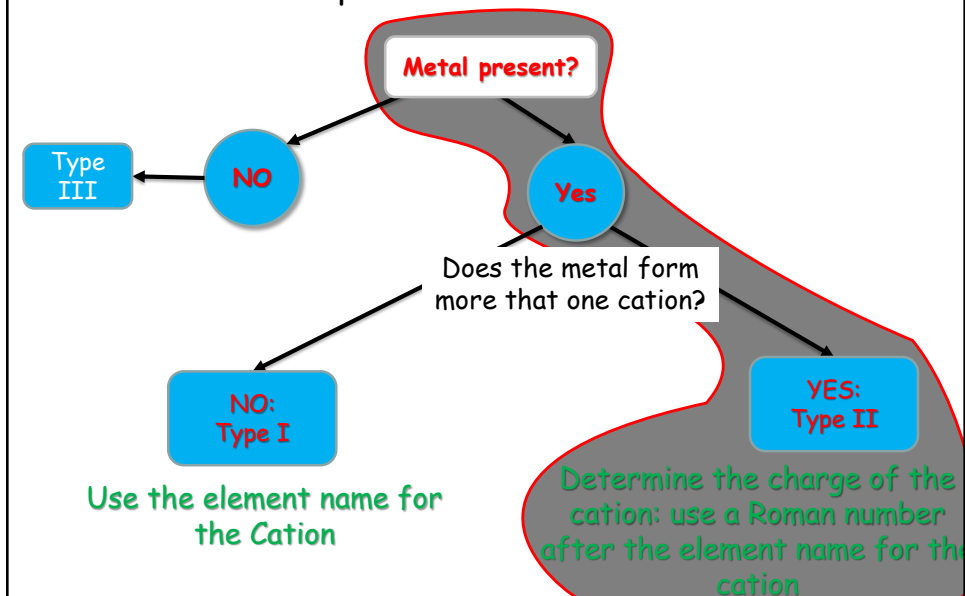
Al_2O_3

Barium sulfide

BaS

Binary Compounds

Composed of two elements



Binary Ionic Compounds (Type II)

- Shown are the elements on the periodic table and their common charges.

	1 IA	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
2	Li ⁺		<div>H⁺</div>												N ³⁻	O ²⁻	F ⁻	
3	Na ⁺	Mg ²⁺	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB			P ³⁻	S ²⁻	Cl ⁻	
4	K ⁺	Ca ²⁺				Cr ³⁺	Mn ²⁺	Fe ³⁺	Co ³⁺	Ni ²⁺	Cu ²⁺						Br ⁻	
5		Sr ²⁺															I ⁻	
6		Ba ²⁺																
7																		
				</														

Binary Ionic Compounds (Type II)

Common Type II Cations

Common Type II Cations

Ion	Systematic Name	Older Name
Fe^{3+}	iron(III)	ferric
Fe^{2+}	iron(II)	ferrous
Cu^{2+}	copper(II)	cupric
Cu^{+}	copper(I)	cuprous
Co^{3+}	cobalt(III)	cobaltic
Co^{2+}	cobalt(II)	cobaltous
Sn^{4+}	tin(IV)	stannic
Sn^{2+}	tin(II)	stannous
Pb^{4+}	lead(IV)	plumbic
Pb^{2+}	lead(II)	plumbous
Hg^{2+}	mercury(II)	mercuric
Hg_2^{2+*}	mercury(I)	mercurous

*Mercury(I) ions always occur bound together in pairs to form Hg_2^{2+} .

© Cengage Learning. All Rights Reserved.

Binary Ionic Compounds (Type II)

- Examples:

CuBr Copper(I) bromide

FeS Iron(II) sulfide

PbO_2 Lead(IV) oxide

Binary Ionic Compounds (Type II)

- Examples:

Tin(II) fluoride



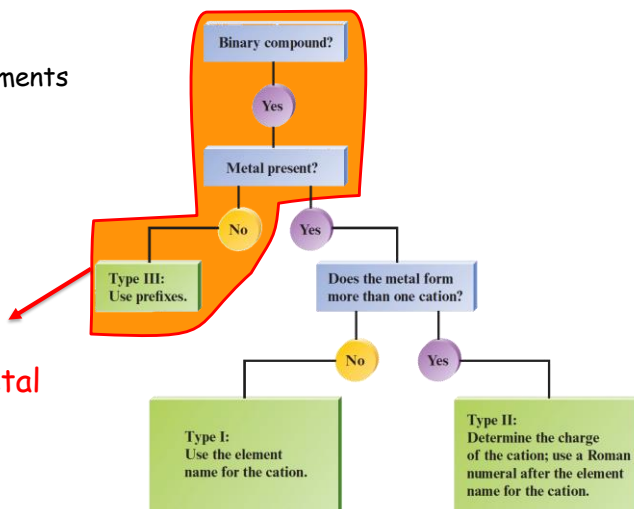
Manganese (IV) sulfide



Type III

Binary Compounds:
Composed of two elements

Binary Compounds
Nonmetal — nonmetal



Rules for Naming **Type III** Binary Compounds

Formed between **two nonmetals**.

1. The first element in the formula is named first, and the full element name is used.
2. The second element is named as though it were an anion (**-ide**).
3. **Prefixes** are used to denote the numbers of atoms present.
4. The prefix *mono-* is never used for naming the first element.

Copyright © Cengage Learning.
All rights reserved

14

Prefixes Used to Indicate Numbers in Chemical Names

Examples:

CO_2 Carbon **dioxide**

SF_6 Sulfur **hexafluoride**

N_2O_4 Dinitrogen **tetroxide**

Table 5.3 ▶ Prefixes Used to Indicate Numbers in Chemical Names

Prefix	Number Indicated
<i>mono-</i>	1
<i>di-</i>	2
<i>tri-</i>	3
<i>tetra-</i>	4
<i>penta-</i>	5
<i>hexa-</i>	6
<i>hepta-</i>	7
<i>octa-</i>	8

© Cengage Learning. All Rights Reserved.

Learning Check

Name each of the following ionic or molecular compounds.

- A. BF_3
- B. OCl_2
- C. Al_2O_3
- D. Ni_3PO_4

Polyatomic Ions

- Polyatomic ions are charged entities composed of several atoms bound together.
- They have special names and must be memorized.

Binary Ionic Compounds (Type I & II)

- Compounds with polyatomic ions are named with the **cation** (type I & II) and **anion** name (without **-ide**)

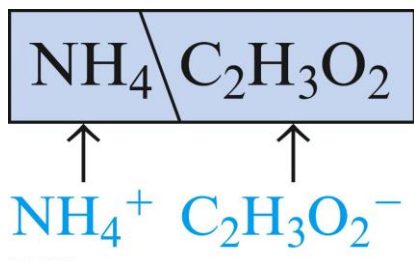
Names of Common Polyatomic Ions

Names of Common Polyatomic Ions

Ion	Name	Ion	Name
NH_4^+	ammonium	CO_3^{2-}	carbonate
NO_2^-	nitrite	HCO_3^-	hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	nitrate	ClO^-	hypochlorite
SO_3^{2-}	sulfite	ClO_2^-	chlorite
SO_4^{2-}	sulfate	ClO_3^-	chlorate
HSO_4^-	hydrogen sulfate (bisulfate is a widely used common name)	ClO_4^-	perchlorate
OH^-	hydroxide	$\text{C}_2\text{H}_3\text{O}_2^-$	acetate
CN^-	cyanide	MnO_4^-	permanganate
PO_4^{3-}	phosphate	$\text{Cr}_2\text{O}_7^{2-}$	dichromate
HPO_4^{2-}	hydrogen phosphate	CrO_4^{2-}	chromate
H_2PO_4^-	dihydrogen phosphate	O_2^{2-}	peroxide

© Cengage Learning. All Rights Reserved.

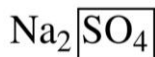
- Naming ionic compounds containing polyatomic ions follows rules similar to those for binary compounds.



Ammonium acetate

21

Examples



Sodium sulfate



Iron(III) phosphate



Aluminum carbonate

22

Nomenclature (binary compounds)																																	
Type I	Type II	Type III																															
Metal + nonmetal	Metal + nonmetal	nonmetal + nonmetal																															
<p>The metal has only one charge and takes the name of the element</p> <p>Example: KCl Potassium chloride MgBr₂ Magnesium bromide</p> <p>Common Type I cations</p> <table border="1"> <tr><td>Alkali,</td></tr> <tr><td>Alkaline</td></tr> <tr><td>Al³⁺,</td></tr> <tr><td>Ag⁺,</td></tr> <tr><td>Zn²⁺</td></tr> </table>	Alkali,	Alkaline	Al ³⁺ ,	Ag ⁺ ,	Zn ²⁺	<p>The metal has a variable oxidation state (different charge). A Roman number indicates the charge</p> <p>Ending changes to -ide</p> <p>Examples: CuBr Copper(I) bromide FeS Iron(II) sulfide</p> <p>Table 5.2 Common Type II Cations</p> <table border="1"> <thead> <tr> <th>Ion</th> <th>Systematic Name</th> </tr> </thead> <tbody> <tr><td>Fe³⁺</td><td>iron(III)</td></tr> <tr><td>Fe²⁺</td><td>iron(II)</td></tr> <tr><td>Cu²⁺</td><td>copper(II)</td></tr> <tr><td>Cu⁺</td><td>copper(I)</td></tr> <tr><td>Co³⁺</td><td>cobalt(III)</td></tr> <tr><td>Co²⁺</td><td>cobalt(II)</td></tr> <tr><td>Sn⁴⁺</td><td>tin(IV)</td></tr> <tr><td>Sn²⁺</td><td>tin(II)</td></tr> <tr><td>Pb⁴⁺</td><td>lead(IV)</td></tr> <tr><td>Pb²⁺</td><td>lead(II)</td></tr> <tr><td>Hg²⁺</td><td>mercury(II)</td></tr> <tr><td>Hg₂²⁺</td><td>mercury(I)</td></tr> </tbody> </table> <p>*Mercury(I) ions always occur bound together in pairs</p>	Ion	Systematic Name	Fe ³⁺	iron(III)	Fe ²⁺	iron(II)	Cu ²⁺	copper(II)	Cu ⁺	copper(I)	Co ³⁺	cobalt(III)	Co ²⁺	cobalt(II)	Sn ⁴⁺	tin(IV)	Sn ²⁺	tin(II)	Pb ⁴⁺	lead(IV)	Pb ²⁺	lead(II)	Hg ²⁺	mercury(II)	Hg ₂ ²⁺	mercury(I)	<p>For nonmetal+nonmetal, prefixes indicate the number of atoms.</p> <p>Ending changes to -ide</p> <p>Example: tetranitrogen nonachloride</p> <p>Step 1: N₄ Step 2: N₄Cl₉</p> <p>Example: O₂F</p> <p>Step 1: dioxygen Step 2: dioxygen monofluoride</p> <p><u>Prefixes</u></p> <p>1 – mono 2 – di 3 – tri 4 – tetra 5 – penta 6 – hexa 7 – hepta 8 – octa 9 – nona 10 – deca</p>
Alkali,																																	
Alkaline																																	
Al ³⁺ ,																																	
Ag ⁺ ,																																	
Zn ²⁺																																	
Ion	Systematic Name																																
Fe ³⁺	iron(III)																																
Fe ²⁺	iron(II)																																
Cu ²⁺	copper(II)																																
Cu ⁺	copper(I)																																
Co ³⁺	cobalt(III)																																
Co ²⁺	cobalt(II)																																
Sn ⁴⁺	tin(IV)																																
Sn ²⁺	tin(II)																																
Pb ⁴⁺	lead(IV)																																
Pb ²⁺	lead(II)																																
Hg ²⁺	mercury(II)																																
Hg ₂ ²⁺	mercury(I)																																