3.5 Names and Formulas of Ionic Compounds

Name the cation first, followed by the anion.

Anions usually have an "-ide" ending:

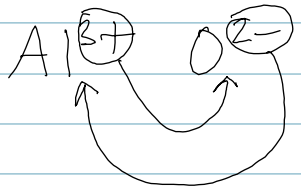
chlorine	Cl^-	chloride
fluorine	F^-	fluoride
oxygen	O^{2-}	oxide

Cations that can only have one charge:

Group 1A:	+1
Group 2A	+2
Al	+3
Zn	+2
Ag (silver)	+1

Sodium chloride	Na^+	Cl^-	$NaCl$
magnesium oxide	Mg^{2+}	O^{2-}	MgO
calcium chloride	Ca^{2+}	Cl^-	$CaCl_2$

aluminum oxide



Al_2O_3 ← $3 \times -2 = -6$

↑

$2 \times +3 = +6$

sodium nitrate	Na^+	NO_3^-	$NaNO_3$
sodium carbonate	Na^+	CO_3^{2-}	Na_2CO_3
zinc nitrate	Zn^{2+}	NO_3^-	

$Zn(NO_3)_2$

↖ applies to everything inside parentheses

Naming Ionic Compounds (continued)

How do we name ionic compounds in which the cation is an element that can have more than one charge?

For example, the name "iron chloride" could refer to $FeCl_2$ or $FeCl_3$.

To specify the charge of the cation, write the charge in Roman numerals after its name:

$FeCl_2$ iron(II) chloride
$FeCl_3$ iron (III) chloride

$SnCl_2$ tin(II) chloride
$SnCl_4$ tin(IV) chloride

PbO_2 lead (IV) oxide
↓ ↓ $2 \times -2 = -4$
$+4$

-ous (smaller charge)
-ic (larger charge)

$FeCl_2$ ferrous chloride
$FeCl_2$ ferric chloride

TABLE 3.4 Some Metals That Form Cations with Different Charges

Metal	Ion	Name	Older Name*
Chromium	Cr^{2+}	Chromium(II)	Chromous
	Cr^{3+}	Chromium(III)	Chromic
Iron	Fe^{2+}	Iron(II)	Ferrous
	Fe^{3+}	Iron(III)	Ferric
Cobalt	Co^{2+}	Cobalt(II)	Cobaltous
	Co^{3+}	Cobalt(III)	Cobaltic
Copper	Cu^{+}	Copper(I)	Cuprous
	Cu^{2+}	Copper(II)	Cupric
Tin	Sn^{2+}	Tin(II)	Stannous
	Sn^{4+}	Tin(IV)	Stannic
Mercury	Hg_2^{2+}	Mercury(I)	Mercurous
	Hg^{2+}	Mercury(II)	Mercuric
Lead	Pb^{2+}	Lead(II)	Plumbous
	Pb^{4+}	Lead(IV)	Plumbic

*An older naming system substitutes the names found in this column for the name of the metal and its charge. Under this system, chromium(II) oxide is named chromous oxide. Additionally, the suffix *-ous* indicates the ion with the lesser charge and *-ic* indicates the ion with the greater charge. We will *not* use the older system in this text.

TABLE 3.5 Some Common Polyatomic Ions

Name	Formula	Name	Formula
Acetate	$C_2H_3O_2^-$	Hypochlorite	ClO^-
Carbonate	CO_3^{2-}	Chlorite	ClO_2^-
Hydrogen carbonate (or bicarbonate)	HCO_3^-	Chlorate	ClO_3^-
Hydroxide	OH^-	Perchlorate	ClO_4^-
Nitrite	NO_2^-	Permanganate	MnO_4^-
Nitrate	NO_3^-	Sulfite	SO_3^{2-}
Chromate	CrO_4^{2-}	Hydrogen sulfite (or bisulfite)	HSO_3^-
Dichromate	$Cr_2O_7^{2-}$	Sulfate	SO_4^{2-}
Phosphate	PO_4^{3-}	Hydrogen sulfate (or bisulfate)	HSO_4^-
Hydrogen phosphate	HPO_4^{2-}	Cyanide	CN^-
Dihydrogen phosphate	$H_2PO_4^-$	Peroxide	O_2^{2-}
Ammonium	NH_4^+		

Oxyanions
-ate -ite

NO_3^- - nitrate
NO_2^- - nitrite
SO_4^{2-} - sulfate
SO_3^{2-} - sulfite

If there are more then two possibilities for the number of oxygens, use *hypo/per* :

ClO_3^- chlor**ate** ClO_4^- **per**chlorate
ClO_2^- chlor**ite** ClO^- **hypo**chlorite

Greek Prefixes Used for Naming Molecular Compounds:

1 = mono-	6 = hexa-
2 = di-	7 = hepta-
3 = tri-	8 = octa-
4 = tetra-	9 = nona-
5 = penta-	10 = deca-

NaClO

Hydrates

$MgSO_4 \cdot 7H_2O$

magnesium sulfate heptahydrate

3.6: Naming Molecular Compounds

(nonmetal atoms only)

The name of the "more metallic" element comes first. The second element in the name will have the "-ide" ending.

HCl - hydrogen chloride

CO_2 - carbon dioxide

CO - carbon monoxide

P_2O_5 - diphosphorus pentoxide

MgF_2 - magnesium fluoride (ionic)

CuF_2 - copper (II) fluoride (ionic)

SF_2 - sulfur difluoride (molecular)

Naming Acids

Acids consist of hydrogen bonded to an anion.

"-ide" anions become "hydro....ic acid"

Oxyacids: "-ate" anions become "....ic acid"

"-ite" anions become "....ous acid"

HCl hydrochloric acid

H_2S hydrosulfuric acid

HNO_3 - nitric acid

HNO_2 - nitrous acid

H_2SO_4 - sulfuric acid

$HClO_4$ - perchloric acid