

**WRITING AND NAMING
CHEMICAL FORMULAS**

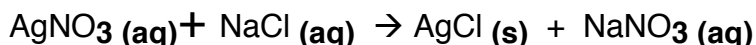
PURPOSE: The purpose of this lab is to write the names and formulas of chemical compounds so that eventually the students will be able to write complete balanced chemical equations.

I. INTRODUCTION

So far you have learned what a chemical symbol is. For example, Pb is the symbol for the element lead. Elements are not often found pure in nature. Most elements are chemically combined in a definite ratio with other elements. These types of substances are called compounds. Most of the earth's hydrogen is not in the form H₂, but is in water in the form H₂O. Just as elements have symbols, compounds have formulas. It is very important that a chemistry student learn how to name formulas and learn to write the correct formula from a given name.

The elements in a compound are in a definite or set ratio. Water is always H₂O, never anything else. The ratio is always 2 hydrogens to 1 oxygen. This definite composition is what makes compounds unique from mixtures. In experiment 5 you learned that a mixture of two substances can be in any ratio or proportion.

Chemistry is largely about describing chemical reactions and predicting their results. In order to correctly write a chemical equation we must first learn how to write and name chemical formulas. For example, we may be given a reaction in sentence form: When aqueous silver nitrate reacts with aqueous sodium chloride a precipitate silver chloride is formed and the sodium and nitrate ions remain in solution. It is impractical to leave the reaction in sentence form. Chemists have a short hand version that looks like this:



Before we can successfully write a chemical equation, we must first learn how to write formulas from the names of compounds and how to name formulas.

In this experiment you will:

Write the chemical formulas of given named compounds

Write the names of given compound formulas

A. NOMENCLATURE OF BINARY COVALENT COMPOUNDS

1. Writing names for Binary Covalent Compounds

a. Write the names of the two elements in the compound

(1) The name of the first element remains the same.

(2) Change the ending of the name of the second element to "ide".

b. Indicate the number of atoms of each element in the compound by using the following Greek prefixes:

mono- 1

penta- 5

octa- 8

di- 2

hexa- 6

nona- 9

tri- 3

hepta- 7

deca- 10

tetra- 4

Note: If mono is the prefix for the first nonmetal, it is omitted from the name.

c. Example: C_3S_2 is **tricarbon disulfide**

2. Writing Formulas for Binary Covalent Compounds

To write the formula of a molecular compound from its name, write the symbols for the two nonmetals and write the subscript for each one as given by its Greek prefix.

Example: disilicon hexachloride is



B. NOMENCLATURE OF IONIC COMPOUNDS AND ACIDS

1. Symbols/Formulas and Names of Ions

a. Monatomic Ions

Nonmetal Ions

<u>SYMBOL</u>	<u>NAME</u>	<u>SYMBOL</u>	<u>NAME</u>	<u>SYMBOL</u>	<u>NAME</u>
H ⁺	hydrogen	F ⁻	fluoride	O ²⁻	oxide
H ⁻	hydride	Cl ⁻	chloride	S ²⁻	sulfide
		Br ⁻	bromide	N ³⁻	nitride
		I ⁻	iodide	P ³⁻	phosphide

Metal Ions

<u>SYMBOL</u>	<u>IUPAC name</u>	<u>SYMBOL</u>	<u>IUPAC NAME</u>	<u>COMMON NAME</u>
Li ⁺	lithium	Cr ²⁺	chromium (II)	chromous
Na ⁺	sodium	Cr ³⁺	chromium (III)	chromic
K ⁺	potassium	Mn ²⁺	manganese (II)	manganous
Rb ⁺	rubidium	Mn ³⁺	manganese (III)	manganic
Cs ⁺	cesium	Fe ²⁺	iron (II)	ferrous
		Fe ³⁺	iron (III)	ferric
Mg ²⁺	magnesium	Co ²⁺	cobalt (II)	cobaltous
Ca ²⁺	calcium	Co ³⁺	cobalt (III)	cobaltic
Sr ²⁺	strontium	Ni ²⁺	nickel (II)	nickelous
Ba ²⁺	barium	Ni ³⁺	nickel (III)	nickelic
		Cu ⁺	copper (I)	cuprous
Ag ⁺	silver	Cu ²⁺	copper (II)	cupric
Zn ²⁺	zinc			
Cd ²⁺	cadmium	Sn ²⁺	tin (II)	stannous
Al ³⁺	aluminum	Sn ⁴⁺	tin (IV)	stannic
		Pb ²⁺	lead (II)	plumbous
As ³⁺	arsenic (III)	Pb ⁴⁺	lead (IV)	plumbic
As ⁵⁺	arsenic (V)			
Sb ³⁺	antimony (III)	Au ⁺	gold (I)	aurous
Sb ⁵⁺	antimony (V)	Au ³⁺	gold (III)	auric
Bi ³⁺	bismuth (III)	Hg ₂ ²⁺	mercury (I)	mercurous
Bi ⁵⁺	bismuth (V)	Hg ²⁺	mercury (II)	Mercuric

b. Polyatomic Ions

NH_4^+ ammonium

Cations

Hg_2^{2+} mercury (I) or mercurous

Anions

<u>-1</u>	<u>-2</u>	<u>-3</u>
HSO_3^- bisulfite	SO_3^{2-} sulfite	
HSO_4^- bisulfate	SO_4^{2-} sulfate	
	$\text{S}_2\text{O}_3^{2-}$ thiosulfate	
HCO_3^- bicarbonate	CO_3^{2-} carbonate	
HS^- bisulfide		PO_3^{3-} phosphite
H_2PO_4^- dihydrogen phosphate	HPO_4^{2-} monohydrogen phosphate	PO_4^{3-} phosphate
CN^- cyanide		AsO_4^{3-} arsenate
SCN^- thiocyanate	CrO_4^{2-} chromate	BO_3^{3-} borate
OCN^- cyanate	$\text{Cr}_2\text{O}_7^{2-}$ dichromate	
NO_2^- nitrite		
NO_3^- nitrate	$\text{C}_2\text{O}_4^{2-}$ oxalate	
ClO^- hypochlorite		
ClO_2^- chlorite	O_2^{2-} peroxide	
ClO_3^- chlorate		
ClO_4^- perchlorate		
BrO^- hypobromite		
BrO_2^- bromite		
BrO_3^- bromate		
BrO_4^- perbromate		
IO^- hypoiodite		
IO_2^- iodite		
IO_3^- iodate		
IO_4^- periodate		
MnO_4^- permanganate		
OH^- hydroxide		
$\text{C}_2\text{H}_3\text{O}_2^-$ acetate		

PREFI
XES
AND
SUFFI

XES (what they mean)

-ate "most common variety"

-ide only one kind of atom in the anion

-ite one less oxygen atom than "ate" variety (same charge)

thio- one oxygen atom replaced by S

per- one more oxygen atom than in "ate" variety (same charge)

bi- one H^+ added to divalent anion

hypo- one less oxygen atom than in "ite" variety (same charge)

di- two

2. Writing Formulas for Ionic Compounds and Acids

- Write the symbol (or formula) for each ion, writing the cation first and the anion second.
- Place parentheses around formulas for polyatomic ions.
- Choose subscripts for the ions such that the net charge is zero. (Remember - a polyatomic ion is a single ion, even though it is made of several atoms)
- Be sure the subscripts are in lowest whole number ratio.
- Rewrite the formula without showing the charges.
- If the subscript for a monoatomic ion is 1, the 1 is not shown.
- If the subscript for a polyatomic ion is 1, the 1 is not shown and the parentheses are removed.

3. Writing Systematic Names of Ionic Compounds and Acids

- Write the name of the cation. Be sure to give the correct names for metal cations of variable charge.
- Write the name of the anion.
- DO NOT USE GREEK PREFIXES like di, tri, etc with ionic compounds!**

4. Writing Aqueous Acid Names

Acids are **molecular** compounds that contain hydrogen. However, we write their systematic names as if they were ionic. When acids dissolve in water they have different properties and are given different names, aqueous acid names.

Examples of Acid Names

		SYSTEMATIC NAME	AQUEOUS ACID NAME
BINARY ACIDS	HCl	hydrogen _____ide hydrogen chloride	hydro_____ic acid hydrochloric acid
	H ₂ S	hydrogen sulfide	hydro sulfuric acid
	HI	hydrogen iodide	hydro iodic acid
TERNARY OXY ACIDS	HNO ₂	hydrogen _____ite hydrogen nitrite	_____ous acid nitrous acid
	H ₂ SO ₃	hydrogen sulfite	sulfurous acid
	HBrO	hydrogen hypobromite	hypobromous acid
	HNO ₃	hydrogen _____ate hydrogen nitrate	_____ic acid nitric acid
	H ₃ PO ₄	hydrogen phosphate	phosphoric acid
	HClO ₄	hydrogen perchlorate	perchloric acid

5. WRITING FORMULAS FROM AQUEOUS ACID NAMES

Aqueous acid name	Systematic Name	Formula
Hydro_____ic acid	Hydrogen_____ide	Hydrochloric acid—hydrogen chloride-HCl
_____ous acid	Hydrogen_____ite	Chlorous acid—hydrogen chlorite HClO ₂
_____ic acid	Hydrogen_____ate	Chloric acid—hydrogen chlorate HClO ₃

II. Procedure

A Writing Formulas of Ionic Compounds

Formulas with two monatomic ions in which there is only one form of the metal ion:

Example:

barium oxide

BaO

potassium chloride

aluminum bromide

calcium oxide

strontium nitride

aluminum oxide

cadmium phosphide

silver fluoride

Formulas with two monatomic ions in which there is more than one form of the metal ion

Example:

cuprous fluoride

CuF₂

ferric chloride

copper (I) sulfide

nickel (II) oxide

iron (II) bromide

stannic oxide

plumbic iodide

lead (II) sulfide

gold (III) oxide

Formulas with polyatomic ions

Example:

cadmium chlorate



calcium carbonate

sodium phosphate

aluminum sulfate

cupric acetate

Iron (III) nitrate

ammonium oxalate

aluminum carbonate

B. Naming Formulas of Ionic Compounds

Formulas with monatomic ions

Example:

MgI₂

Magnesium iodide

CaF₂

CuCl₂

LiI

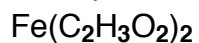
FeO

Pb₃N₄

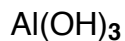
ZnS

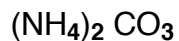
Formulas with polyatomic ions

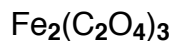
Example:

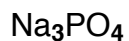


Iron (II) Acetate











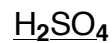


C. Writing Formulas of Acids

Example:

Sulfuric Acid

Hydrogen sulfate



Nitric Acid

Carbonic Acid

Perchloric acid

Example:

Hydroiodic acid

Hydrogen iodide



Hydrobromic acid

Hydrofluoric acid

Example:

Chlorous acid

Hydrogen chlorite



Nitrous acid

Sulfurous acid

D. Naming Acids

Hydrogen chloride

Hydrochloric acid

Example

HCl

H₃PO₄

HCN

HC₂H₃O₂

H₂C₂O₄

HClO

E. Writing Formulas of Covalent Compounds

Example:

Carbon dioxide

CO₂

Sulfur hexafluoride

Carbon tetrachloride

diphosphoours pentoxide

F. Naming Covalent Compounds

N₂O

BF₃

Si₂Br₆

P₂I₄

CHEM. 110 LAB REPORT

Name _____

Date _____

Lab Section _____

Initials _____

EXPERIMENT 6

WRITING AND NAMING CHEMICAL FORMULAS

For each of the following indicate the type of compound using "A" for acid, "I" for ionic or "C" for covalent.

Write the formulas of the following compounds.

Write the names of the following compounds.

___ Sodium nitrite _____ CaBr₂ _____

___ Aluminum bisulfite _____ PbS₂O₃ _____

___ Nitrous acid _____ Cd(NO₃)₂ _____

___ Ferrous Oxide _____ Cu(ClO₃)₂ _____

___ Silver oxalate _____ PbCr₂O₇ _____

___ Iodic acid _____ P₂O₅ _____

___ Chlorine monobromide _____ Al(ClO₃)₃ _____

___ Stannous phosphate _____ Na₃N _____

___ Hydrocyanic acid _____ Sb₂(SO₃)₅ _____

___ Copper (II) hydroxide _____ Hg₂(ClO)₂ _____

___ Sulfurous acid _____ Mg(OH)₂ _____

___ Sulfuric acid _____ P₂O₅ _____

___ Phosphorous acid _____ NH₄Cl _____

___ Periodic acid _____ FeCl₃ _____

___ Dichlorine monoxide _____ FeCl₂ _____

___ Sulfur hexafluoride _____ HF _____

___ Ammonium phosphite _____ CdI₂ _____

