

**Polyatomic compounds** are chemical compounds that contain more than two different elements in their formula (i.e., sulfuric acid =  $\text{H}_2\text{SO}_4$ ). Also, polyatomic compounds usually contain at least one **polyatomic ion** (i.e., 2 hydrogen ions ( $2\text{H}^{+1}$ ) and a sulfate ion ( $\text{SO}_4^{-2}$ ) = sulfuric acid ( $\text{H}_2\text{SO}_4$ )). In this example, sulfate ( $\text{SO}_4^{-2}$ ) is the polyatomic ion. Polyatomic compounds may also contain 2 polyatomic ions (i.e., ammonium ( $\text{NH}_4^{+1}$ ) and hydroxide ( $\text{OH}^{-1}$ ) = ammonium hydroxide ( $\text{NH}_4\text{OH}$ )). Remember, the positive ion (cation) or negative ion (anion), or both, contain two or more different elements in their formula.

**Writing a formula** for a polyatomic compound follows **exactly the same rules** as we used in Part 1. That is, polyatomic chemical compounds are **neutral**, having a charge of zero (i.e., the combination of charges on the cation(s) and anion(s) must add to zero).

**The naming** of polyatomic compounds is **similar** to naming binary compounds but some memorization is required initially. Many polyatomic ions are derived from oxygen-containing acids or "**oxy-acids**". The names and formulas of these oxy acids and their derivatives is your starting point for Part 2 of this independent study.

## I. **OXY ACIDS**

An **oxy acid** is a polyatomic compound containing hydrogen, oxygen and an electronegative element (i.e., Cl, N, S, P, etc.). These acids are sometimes referred to as "mother acids" because many other chemical compounds are derived from them. Therefore, the **names and formulas** of related oxy acids and polyatomic ions are derived from them. The top 5 oxy acids are the main oxy acids used in industry. Use the names already given to help fill in the chart below.

oxy acid chemical name	oxy acid chemical formula
phosphoric acid	$\text{H}_3\text{PO}_4$
sulfuric acid	$\text{H}_2\text{SO}_4$
carbonic acid	$\text{H}_2\text{CO}_3$
nitric acid	$\text{HNO}_3$
chloric acid	$\text{HClO}_3$
fluoric acid	$\text{HFO}_3$
bromic acid	$\text{HBrO}_3$
iodic acid	$\text{HIO}_3$

## J. OXY ACIDS DERIVATIVES

An **oxy acid derivative** may be formed during a chemical reaction when oxygen atom(s) are added to or removed from an **oxy acid**. (**Note:** Although you can write the chemical formulas and names of all oxy acid derivatives using the system described below, some may not exist naturally or be able to be synthetically produced.)

### NAMING and WRITING FORMULAS for OXY ACID DERIVATIVES:

Information in the box below shows how the name and formula of an oxy acid are changed when adding or removing oxygen atoms from the original **oxy acid** formula.

- + if **ONE OXYGEN ATOM IS ADDED**, add prefix "per" to the "ic" acid name  
= persulfuric acid (called "per-ic" acid)
- + **OXY ACID** = sulfuric acid (called "ic" acid, AKA Amother acid@)
- + if **ONE OXYGEN ATOM IS REMOVED**, remove "ic" and add "ous" to acid name  
= sulfurous acid (called "ous" acid)
- + if **TWO OXYGEN ATOMS ARE REMOVED**, add prefix "hypo" to "ous" acid name =  
hyposulfurous acid (called "hypo-ous" acid)

Complete the following table to show how you would name and write the formulas for the oxy acid derivatives of sulfuric acid (use information from the box above).

change in oxy acid formula	oxy acid name	oxy acid formula
add one oxygen atom(*) ("per-ic" acid)	persulfuric acid	H <sub>2</sub> SO <sub>5</sub>
no change ("ic" acid)	sulfuric acid	H <sub>2</sub> SO <sub>4</sub>
remove one oxygen atom(*) ("ous" acid)	sulfurous acid	H <sub>2</sub> SO <sub>3</sub>
remove two oxygen atoms(*) ("hypo-ous" acid)	hyposulfurous acid	H <sub>2</sub> SO <sub>2</sub>

(\*) These are the **derivatives** of the original **oxy acid**. Since the derivatives contain oxygen and are acids (like the original oxy acid), they are also referred to as oxy acids.

**OTHER OXY ACID DERIVATIVES**

Complete a similar table for each of the other four main oxy acids:

a)  $\text{H}_3\text{PO}_4$     b)  $\text{H}_2\text{CO}_3$     c)  $\text{HNO}_3$     d)  $\text{HClO}_3$

change in oxy acid formula	oxy acid name	oxy acid formula
add one oxygen atom ("per-ic" acid)	perphosphoric acid	$\text{H}_3\text{PO}_5$
no change ("ic" acid)	phosphoric acid	$\text{H}_3\text{PO}_4$
remove one oxygen atom ("ous" acid)	phosphorous acid	$\text{H}_3\text{PO}_3$
remove two oxygen atoms ("hypo-ous" acid)	hypophosphorous acid	$\text{H}_3\text{PO}_2$

change in oxy acid formula	oxy acid name	oxy acid formula
add one oxygen atom ("per-ic" acid)	percarbonic acid	$\text{H}_2\text{CO}_4$
no change ("ic" acid)	carbonic acid	$\text{H}_2\text{CO}_3$
remove one oxygen atom ("ous" acid)	carbonous acid	$\text{H}_2\text{CO}_2$
remove two oxygen atoms ("hypo-ous" acid)	hypocarbonous acid	$\text{H}_2\text{CO}$

change in oxy acid formula	oxy acid name	oxy acid formula
add one oxygen atom ("per-ic" acid)	pernitric acid	$\text{HNO}_4$
no change ("ic" acid)	nitric acid	$\text{HNO}_3$
remove one oxygen atom ("ous" acid)	nitrous acid	$\text{HNO}_2$
remove two oxygen atoms ("hypo-ous" acid)	hyponitrous acid	$\text{HNO}$

change in oxy acid formula	oxy acid name	oxy acid formula
add one oxygen atom ("per-ic" acid)	perchloric acid	$\text{HClO}_4$
no change ("ic" acid)	chloric acid	$\text{HClO}_3$
remove one oxygen atom ("ous" acid)	chlorous acid	$\text{HClO}_2$
remove two oxygen atoms ("hypo-ous" acid)	hypochlorous acid	$\text{HClO}$

## Worksheet IJ

Complete the following table in order to practice the naming and formula writing for oxy acids and their derivatives.

chemical name	chemical formula	chemical name	chemical formula
sulfurous acid	$\text{H}_2\text{SO}_3$	persulfuric acid	$\text{H}_2\text{SO}_5$
fluoric acid	$\text{HFO}_3$	fluorous acid	$\text{HFO}_2$
hypophosphorous acid	$\text{H}_3\text{PO}_2$	perphosphoric acid	$\text{H}_3\text{PO}_5$
percarbonic acid	$\text{H}_2\text{CO}_4$	carbonic acid	$\text{H}_2\text{CO}_3$
pernitric acid	$\text{HNO}_4$	hyponitrous acid	$\text{HNO}$
bromous acid	$\text{HBrO}_2$	perbromic acid	$\text{HBrO}_4$
hypoiodous acid	$\text{HIO}$	iodic acid	$\text{HIO}_3$
perfluoric acid	$\text{HFO}_4$	hyposulfurous acid	$\text{H}_2\text{SO}_2$
phosphoric acid	$\text{H}_3\text{PO}_4$	hypochlorous acid	$\text{HClO}$
carbonic acid	$\text{H}_2\text{CO}_3$	nitrous acid	$\text{HNO}_2$
nitrous acid	$\text{HNO}_2$	percarbonic acid	$\text{H}_2\text{CO}_4$
hypochlorous acid	$\text{HClO}$	phosphoric acid	$\text{H}_3\text{PO}_4$

Oxy acids and their derivatives dissociate (separate from) their positive hydrogen ions, forming negative polyatomic anions. These negative ions are commonly found combined with **positive metal ions**. This combination of a **metal cation** and a **polyatomic anion** is called a "**salt**". Some of the names of the polyatomic anions which are derived from the oxy acids are given below. Writing the formula of salts that contain these polyatomic anions follows the same rules you have used in the past (i.e., the chemical compound formed is neutral). The names of the chemical compounds are determined by placing the cation name in front of the polyatomic anion name. Use the examples in the right column as a guide. (**Note:** The  $\text{Aic@}$  acid always results in the  $\text{Aate@}$  anion!)

### K. POLYATOMIC ANIONS from "ic" acids

"ic" acid name and formula	polyatomic anion chemical formula	polyatomic anion chemical name	example of chemical name and formula for sodium salt
phosphoric acid $\text{H}_3\text{PO}_4$	$\text{PO}_4^{-3}$	phosphate	sodium phosphate $\text{Na}_3\text{PO}_4$
sulfuric acid $\text{H}_2\text{SO}_4$	$\text{SO}_4^{-2}$	sulfate	sodium sulfate $\text{Na}_2\text{SO}_4$
carbonic acid $\text{H}_2\text{CO}_3$	$\text{CO}_3^{-2}$	carbonate	sodium carbonate $\text{Na}_2\text{CO}_3$
nitric acid $\text{HNO}_3$	$\text{NO}_3^{-1}$	nitrate	sodium nitrate $\text{NaNO}_3$
chloric acid $\text{HClO}_3$	$\text{ClO}_3^{-1}$	chlorate	sodium chlorate $\text{NaClO}_3$
fluoric acid $\text{HFO}_3$	$\text{FO}_3^{-1}$	fluorate	sodium fluorate $\text{NaFO}_3$
bromic acid $\text{HBrO}_3$	$\text{BrO}_3^{-1}$	bromate	sodium bromate $\text{NaBrO}_3$
iodic acid $\text{HIO}_3$	$\text{IO}_3^{-1}$	iodate	sodium iodate $\text{NaIO}_3$

## L1. POLYATOMIC ANIONS from OXY ACID DERIVATIVES

The following chart shows how you would name the **polyatomic anions** from sulfuric acid and its oxy acid derivatives.

oxy acid	polyatomic anion formula	polyatomic anion name	example of sodium salt
persulfuric acid $\text{H}_2\text{SO}_5$	$\text{SO}_5^{-2}$	persulfate ( <b>ai</b> c acids always result in <b>ate</b> ions)	sodium persulfate $\text{Na}_2\text{SO}_5$
sulfuric acid $\text{H}_2\text{SO}_4$	$\text{SO}_4^{-2}$	sulfate ( <b>ai</b> c acids always result in <b>ate</b> ions)	sodium sulfate $\text{Na}_2\text{SO}_4$
sulfurous acid $\text{H}_2\text{SO}_3$	$\text{SO}_3^{-2}$	sulfite ( <b>ao</b> us acids always result in <b>ite</b> ions)	sodium sulfite $\text{Na}_2\text{SO}_3$
hyposulfurous acid $\text{H}_2\text{SO}_2$	$\text{SO}_2^{-2}$	hyposulfite ( <b>ao</b> us acids always result in <b>ite</b> ions)	sodium hyposulfite $\text{Na}_2\text{SO}_2$

### Practice Problems:

Note: When writing the chemical formulas for the examples below, if more than one polyatomic ion is required in the chemical formula, brackets must be placed around the polyatomic ion.

chemical name	chemical formula	chemical name	chemical formula
potassium persulfate	$\text{K}_2\text{SO}_5$	radium sulfate	$\text{RaSO}_4$
aluminum sulfate	$\text{Al}_2(\text{SO}_4)_3$	boron persulfate	$\text{B}_2(\text{SO}_5)_3$
copper(I) sulfite	$\text{Cu}_2\text{SO}_3$	copper(II) hyposulfite	$\text{CuSO}_2$
ferrous hyposulfite	$\text{FeSO}_2$	iron(III) sulfite	$\text{Fe}_2(\text{SO}_3)_3$
nickel(III) persulfate	$\text{Ni}_2(\text{SO}_5)_3$	nickel(II) hyposulfite	$\text{NiSO}_2$

## L2. POLYATOMIC ANIONS from OXY ACID DERIVATIVES

The following chart shows how you would name the polyatomic anions from phosphoric acid and its oxy acid derivatives.

oxy acid	polyatomic anion formula	polyatomic anion name	example of sodium salt
perphosphoric acid $\text{H}_3\text{PO}_5$	$\text{PO}_5^{-3}$	perphosphate	sodium perphosphate $\text{Na}_3\text{PO}_5$
phosphoric acid $\text{H}_3\text{PO}_4$	$\text{PO}_4^{-3}$	phosphate	sodium phosphate $\text{Na}_3\text{PO}_4$
phosphorous acid $\text{H}_3\text{PO}_3$	$\text{PO}_3^{-3}$	phosphite	sodium phosphite $\text{Na}_3\text{PO}_3$
hypophosphorous acid $\text{H}_3\text{PO}_2$	$\text{PO}_2^{-3}$	hypophosphite	sodium hypophosphite $\text{Na}_3\text{PO}_2$

### Practice Problems:

chemical name	chemical formula	chemical name	chemical formula
lithium perphosphate	$\text{Li}_3\text{PO}_5$	cesium hypophosphite	$\text{Cs}_3\text{PO}_2$
calcium phosphate	$\text{Ca}_3(\text{PO}_4)_2$	magnesium phosphate	$\text{Mg}_3(\text{PO}_4)_2$
aluminum phosphite	$\text{AlPO}_3$	gallium perphosphate	$\text{GaPO}_5$
lead(II) hypophosphite	$\text{Pb}_3(\text{PO}_2)_2$	gold(I) hypophosphite	$\text{Au}_3\text{PO}_2$
mercurous phosphite	$\text{Hg}_3\text{PO}_3$	manganese(IV) phosphite	$\text{Mn}_3(\text{PO}_3)_4$

### L3. POLYATOMIC ANIONS from OXY ACID DERIVATIVES

The following chart shows how you would name the polyatomic anions from carbonic acid and its oxy acid derivatives.

oxy acid	polyatomic anion formula	polyatomic anion name	example of sodium salt
percarbonic acid $\text{H}_2\text{CO}_4$	$\text{CO}_4^{-2}$	percarbonate	sodium percarbonate $\text{Na}_2\text{CO}_4$
carbonic acid $\text{H}_2\text{CO}_3$	$\text{CO}_3^{-2}$	carbonate	sodium carbonate $\text{Na}_2\text{CO}_3$
carbonous acid $\text{H}_2\text{CO}_2$	$\text{CO}_2^{-2}$	carbonite	sodium carbonite $\text{Na}_2\text{CO}_2$
hypocarbonous acid $\text{H}_2\text{CO}$	$\text{CO}^{-2}$	hypocarbonite	sodium hypocarbonite $\text{Na}_2\text{CO}$

#### Practice Problems:

chemical name	chemical formula	chemical name	chemical formula
rubidium percarbonate	$\text{Rb}_2\text{CO}_4$	potassium carbonite	$\text{K}_2\text{CO}_2$
beryllium carbonate	$\text{BeCO}_3$	aluminum percarbonate	$\text{Al}_2(\text{CO}_4)_3$
boron carbonite	$\text{B}_2(\text{CO}_2)_3$	silver hypocarbonite	$\text{Ag}_2\text{CO}$
cobalt(II) hypocarbonite	$\text{CoCO}$	nickel(II) carbonate	$\text{NiCO}_3$
cuprous percarbonate	$\text{Cu}_2\text{CO}_4$	tin(IV) carbonite	$\text{Sn}(\text{CO}_2)_2$



## L4. POLYATOMIC ANIONS from OXY ACID DERIVATIVES

The following chart shows how you would name the polyatomic anions from nitric acid and its oxy acid derivatives.

oxy acid	polyatomic anion formula	polyatomic anion name	example of sodium salt
pernitric acid $\text{HNO}_4$	$\text{NO}_4^{-1}$	pernitrate	sodium pernitrate $\text{NaNO}_4$
nitric acid $\text{HNO}_3$	$\text{NO}_3^{-1}$	nitrate	sodium nitrate $\text{NaNO}_3$
nitrous acid $\text{HNO}_2$	$\text{NO}_2^{-1}$	nitrite	sodium nitrite $\text{NaNO}_2$
hyponitrous acid $\text{HNO}$	$\text{NO}^{-1}$	hyponitrite	sodium hyponitrite $\text{NaNO}$

### Practice Problems:

chemical name	chemical formula	chemical name	chemical formula
zinc pernitrate	$\text{Zn}(\text{NO}_4)_2$	antimony(V) nitrate	$\text{Sb}(\text{NO}_3)_5$
barium nitrate	$\text{Ba}(\text{NO}_3)_2$	mercury(I) nitrite	$\text{HgNO}_2$
boron nitrite	$\text{B}(\text{NO}_2)_3$	iron(II) hyponitrite	$\text{Fe}(\text{NO})_2$
arsenic(V) hyponitrite	$\text{As}(\text{NO})_5$	gold(III) nitrite	$\text{Au}(\text{NO}_2)_3$
plumbous nitrate	$\text{Pb}(\text{NO}_3)_2$	calcium pernitrate	$\text{Ca}(\text{NO}_4)_2$

## L5. POLYATOMIC ANIONS from OXY ACID DERIVATIVES

The following chart shows how you would name the polyatomic anions from chloric acid and its oxy acid derivatives.

oxy acid	polyatomic anion formula	polyatomic anion name	example of sodium salt
perchloric acid $\text{HClO}_4$	$\text{ClO}_4^{-1}$	perchlorate	sodium perchlorate $\text{NaClO}_4$
chloric acid $\text{HClO}_3$	$\text{ClO}_3^{-1}$	chlorate	sodium chlorate $\text{NaClO}_3$
chlorous acid $\text{HClO}_2$	$\text{ClO}_2^{-1}$	chlorite	sodium chlorite $\text{NaClO}_2$
hypochlorous acid $\text{HClO}$	$\text{ClO}^{-1}$	hypochlorite	sodium hypochlorite $\text{NaClO}$

### Practice Problems:

chemical name	chemical formula	chemical name	chemical formula
lithium perchlorate	$\text{LiClO}_4$	magnesium chlorate	$\text{Mg}(\text{ClO}_3)_2$
aluminum chlorate	$\text{Al}(\text{ClO}_3)_3$	boron chlorite	$\text{B}(\text{ClO}_2)_3$
zinc chlorite	$\text{Zn}(\text{ClO}_2)_2$	copper(II) hypochlorite	$\text{Cu}(\text{ClO})_2$
tin(II) hypochlorite	$\text{Sn}(\text{ClO})_2$	cobalt(II) perchlorate	$\text{Co}(\text{ClO}_4)_2$
nickelous hypochlorite	$\text{Ni}(\text{ClO})_2$	antimony(V) chlorate	$\text{Sb}(\text{ClO}_3)_5$

### M. ACID POLYATOMIC ANIONS from OXY ACIDS

Oxy acids and their derivatives with two or more hydrogen ions in their chemical formulas may form **acid polyatomic anions**. The 3 oxy acids that may form acid polyatomic anions are:  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{CO}_3$  and  $\text{H}_3\text{PO}_4$ . Acid polyatomic anions are formed when only one hydrogen ion dissociates@ (separates) from the oxy acid. This leaves a negative polyatomic anion with a hydrogen ion still attached to it. Phosphoric acid ( $\text{H}_3\text{PO}_4$ ) has the ability to lose **one or two** hydrogen ions and still remain an acid polyatomic anion. These acid polyatomic anions can form **acid salts** when they combine with **positive metal ions**.

oxy acid formula	acid polyatomic anion (remove 1 or 2 $\text{H}^{+1}$ ions)	acid anion name	examples (formula and name)
$\text{H}_2\text{SO}_4$	$\text{HSO}_4^{-1}$	hydrogen sulfate (preferred name)  or  bisulfate (common name)	$\text{NaHSO}_4$  sodium hydrogen sulfate or sodium bisulfate
$\text{H}_2\text{CO}_3$	$\text{HCO}_3^{-1}$	hydrogen carbonate (preferred)  or  bicarbonate (common)	$\text{NaHCO}_3$  sodium hydrogen carbonate or sodium bicarbonate
$\text{H}_3\text{PO}_4$	$\text{H}_2\text{PO}_4^{-1}$	dihydrogen phosphate (preferred)  or  (no common name)	$\text{NaH}_2\text{PO}_4$  sodium dihydrogen phosphate
$\text{H}_3\text{PO}_4$	$\text{HPO}_4^{-2}$	monohydrogen phosphate (preferred)  or  biphosphate (common)	$\text{Na}_2\text{HPO}_4$  sodium monohydrogen phosphate or sodium biphosphate

# N1. ACID ANIONS from H<sub>2</sub>SO<sub>4</sub> and its DERIVATIVES

The following chart outlines the formulas and names of acid polyatomic anions derived from sulfuric acid and its derivatives. Study the chart below and identify the system used to write formulas and names for these **acid anions**.

oxy acid formula	acid anion formula (remove 1 H <sup>+</sup> )	acid anion chemical name	examples
H <sub>2</sub> SO <sub>5</sub>	HSO <sub>5</sub> <sup>-1</sup>	hydrogen persulfate or (no common name)	NaHSO <sub>5</sub> sodium hydrogen persulfate
H <sub>2</sub> SO <sub>4</sub>	HSO <sub>4</sub> <sup>-1</sup>	hydrogen sulfate or bisulfate	NaHSO <sub>4</sub> sodium hydrogen sulfate or sodium bisulfate
H <sub>2</sub> SO <sub>3</sub>	HSO <sub>3</sub> <sup>-1</sup>	hydrogen sulfite or bisulfite	NaHSO <sub>3</sub> sodium hydrogen sulfite or sodium bisulfite
H <sub>2</sub> SO <sub>2</sub>	HSO <sub>2</sub> <sup>-1</sup>	hydrogen hyposulfite or (no common name)	NaHSO <sub>2</sub> sodium hydrogen hyposulfite

**N2. ACID ANIONS from  $\text{H}_2\text{CO}_3$  and its DERIVATIVES**

Complete the chart below using the formula writing and naming system demonstrated in N1.

oxy acid formula	acid anion formula (remove 1 $\text{H}^{+1}$ )	acid anion chemical name	examples
$\text{H}_2\text{CO}_4$	$\text{HCO}_4^{-1}$	hydrogen percarbonate  (no common name)	$\text{NaHCO}_4$ sodium hydrogen percarbonate
$\text{H}_2\text{CO}_3$	$\text{HCO}_3^{-1}$	hydrogen carbonate  or  bicarbonate	$\text{NaHCO}_3$ sodium hydrogen carbonate or sodium bicarbonate
$\text{H}_2\text{CO}_2$	$\text{HCO}_2^{-1}$	hydrogen carbonite or bicarbonite	$\text{NaHCO}_2$ sodium hydrogen carbonite or sodium bicarbonite
$\text{H}_2\text{CO}$	$\text{HCO}^{-1}$	hydrogen hypocarbonite  (no common name)	$\text{NaHCO}$ sodium hydrogen hypocarbonite

**N3. ACID ANIONS from  $\text{H}_3\text{PO}_4$  and its DERIVATIVES**

Complete the table below using the formula writing and naming system demonstrated in N1.

Since one or two hydrogens can dissociate (separate) from these acids without losing all the hydrogens, a prefix must be used to indicate how many hydrogen ions remain bonded to the acid anion.

oxy acid formula	acid anion formula (remove 1 $\text{H}^{+1}$ )	acid anion chemical name	examples
$\text{H}_3\text{PO}_5$	$\text{H}_2\text{PO}_5^{-1}$	dihydrogen perphosphate  (no common name)	$\text{NaH}_2\text{PO}_5$ sodium dihydrogen perphosphate
$\text{H}_3\text{PO}_4$	$\text{H}_2\text{PO}_4^{-1}$	<b>dihydrogen phosphate</b>  (no common name)	<b><math>\text{NaH}_2\text{PO}_4</math></b> <b>sodium dihydrogen phosphate</b>
$\text{H}_3\text{PO}_3$	$\text{H}_2\text{PO}_3^{-1}$	dihydrogen phosphite  (no common name)	$\text{NaH}_2\text{PO}_3$ sodium dihydrogen phosphate
$\text{H}_3\text{PO}_2$	$\text{H}_2\text{PO}_2^{-1}$	dihydrogen hypophosphite  (no common name)	$\text{NaH}_2\text{PO}_2$ sodium dihydrogen hypophosphite

**N4. ACID ANIONS from  $\text{H}_3\text{PO}_4$  and DERIVATIVES**

Complete the following table using the formula writing and naming system demonstrated in N1, N2 and N3.

oxy acid formula	acid anion formula (remove 2 $\text{H}^{+1}$ )	acid anion chemical name	examples
$\text{H}_3\text{PO}_5$	$\text{HPO}_5^{-2}$	monohydrogen perphosphate  (no common name)	$\text{Na}_2\text{HPO}_5$  sodium monohydrogen perphosphate
$\text{H}_3\text{PO}_4$	$\text{HPO}_4^{-2}$	monohydrogen phosphate  or  biphosphate	$\text{Na}_2\text{HPO}_4$ sodium monohydrogen phosphate or sodium biphosphate
$\text{H}_3\text{PO}_3$	$\text{HPO}_3^{-2}$	monohydrogen phosphite or biphosphite	$\text{Na}_2\text{HPO}_3$ sodium monohydrogen phosphite or sodium biphosphite
$\text{H}_3\text{PO}_2$	$\text{HPO}_2^{-2}$	monohydrogen hypophosphite  (no common name)	$\text{Na}_2\text{HPO}_2$ sodium monohydrogen hypophosphite

## Worksheet MN

chemical name	chemical formula	chemical name	chemical formula
sodium hydrogen sulfate	$\text{NaHSO}_4$	lithium hydrogen persulfate	$\text{LiHSO}_5$
potassium bicarbonate	$\text{KHCO}_3$	rubidium hydrogen hypophosphite	$\text{RbHCO}$
magnesium dihydrogen phosphite	$\text{Mg}(\text{H}_2\text{PO}_3)_2$	calcium dihydrogen hypophosphite	$\text{Ca}(\text{H}_2\text{PO}_2)_2$
aluminum monohydrogen hypophosphite	$\text{Al}_2(\text{HPO}_2)_3$	boron monohydrogen phosphite	$\text{B}_2(\text{HPO}_3)_3$
zinc bisulfite	$\text{Zn}(\text{HSO}_3)_2$	silver hydrogen sulfate	$\text{AgHSO}_4$
barium hydrogen carbonite	$\text{Ba}(\text{HCO}_2)_2$	strontium monohydrogen hypophosphite	$\text{SrHPO}_2$
nickel(II) dihydrogen perphosphate	$\text{Ni}(\text{H}_2\text{PO}_5)_2$	copper(I) hydrogen percarbonate	$\text{CuHCO}_4$
cupric hydrogen hypocarbonite	$\text{Cu}(\text{HCO})_2$	iron(II) dihydrogen phosphite	$\text{Fe}(\text{H}_2\text{PO}_3)_2$
iron(III) biphosphite	$\text{Fe}_2(\text{HPO}_3)_3$	cobalt(III) hydrogen hyposulfite	$\text{Co}(\text{HSO}_2)_3$
mercurous hydrogen persulfate	$\text{HgHSO}_5$	mercury(I) hydrogen sulfite	$\text{HgHSO}_3$
tin(IV) biphosphate	$\text{Sn}(\text{HPO}_4)_2$	calcium hydrogen carbonite	$\text{Ca}(\text{HCO}_2)_2$
sodium hydrogen carbonate	$\text{NaHCO}_3$	manganese(IV) hydrogen carbonate	$\text{Mn}(\text{HCO}_3)_4$
plumbic dihydrogen hypophosphite	$\text{Pb}(\text{H}_2\text{PO}_2)_4$	lead(IV) dihydrogen phosphate	$\text{Pb}(\text{H}_2\text{PO}_4)_4$
arsenic(V) monohydrogen perphosphate	$\text{As}_2(\text{HPO}_5)_5$	antimony(V) monohydrogen perphosphate	$\text{Sb}_2(\text{HPO}_5)_5$
aurous hydrogen carbonite	$\text{AuHCO}_2$	arsenic(III) dihydrogen perphosphate	$\text{As}(\text{H}_2\text{PO}_5)_3$



## O. MISCELLANEOUS POLYATOMIC IONS

Other polyatomic anions and cations are commonly found in chemical compounds. The following are just two examples of other polyatomic ions. Complete the table using rules you have learned in Part 2 of this independent study.

polyatomic ion name	<b>ammonium</b>	<b>hydroxide</b>
polyatomic ion symbol	<b>NH<sub>4</sub><sup>+1</sup></b>	<b>OH<sup>-1</sup></b>
example of chemical formula with this ion	NH <sub>4</sub> Cl	NaOH
chemical name of example above	ammonium chloride	sodium hydroxide

## MISCELLANEOUS POLYATOMIC IONS - more examples

The following chemical formulas and chemical names contain other common polyatomic ions. Use the "**Oxidation States**" sheet to determine the formula of the ion being used and its charge and complete this table.

chemical name	chemical formula	chemical name	chemical formula
sodium thiocyanate	NaSCN	magnesium dichromate	MgCr <sub>2</sub> O <sub>7</sub>
calcium permanganate	Ca(MnO <sub>4</sub> ) <sub>2</sub>	lead(II) or plumbous cyanide	Pb(CN) <sub>2</sub>
ferrous acetate	Fe(CH <sub>3</sub> CO <sub>2</sub> ) <sub>2</sub>	aluminum cyanate	Al(OCN) <sub>3</sub>
copper(II) chromate	CuCrO <sub>4</sub>	ammonium thiocyanate	NH <sub>4</sub> SCN
gold(III) dichromate	Au <sub>2</sub> (Cr <sub>2</sub> O <sub>7</sub> ) <sub>3</sub>	lithium acetate	LiCH <sub>3</sub> CO <sub>2</sub>
arsenic cyanate	As(OCN) <sub>5</sub>	potassium permanganate	KMnO <sub>4</sub>
potassium cyanide	KCN	lead(IV) or plumbic chromate	Pb(CrO <sub>4</sub> ) <sub>2</sub>
boron hydroxide	B(OH) <sub>3</sub>	ammonium hypocarbonite	(NH <sub>4</sub> ) <sub>2</sub> CO