

## Chapter 9-Chemical Names and Formulae

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### 9.1:Naming Ions

- Group 1A, 2A and 3A elements lose electrons, forming cations with a positive charge equal to their Group number.
- the name of these cations is simply the name of the element
- the formula shows the charge and amount

#### Example:

Sodium is in Group 1A, therefore it forms a cation called 'the sodium ion' with the formula,  $\text{Na}^+$

Determine the name, charge on the ion and formula for the following elements in Group 1A, 2A and 3A

- Rubidium
- Strontium
- Indium

- Group 5A, 6A, and 7A elements gain electrons, forming ions with a negative charge found by subtracting 8 from the Group number
- the name of these anions is altered to the name of the element with "-ide" as an ending
- the formula shows the charge and amount

**Example:**

Oxygen is in Group 6A, therefore it forms an anion called oxide with the charge of  $2^-$  ( $6-8$ ) and the formula of  $O^{2-}$

Determine the name, charge on the ion and formula for the following elements in Group 5A, 6A and 7A

- Arsenic
- Selenium
- Astatine

*The majority of the elements in Group 4A and 8A do not tend to form ions.*

**Table 9.1**

**Ionic Charges of Representative Elements**

1A	2A	3A	4A	5A	6A	7A	8A
Li <sup>+</sup>	Be <sup>2+</sup>			N <sup>3-</sup>	O <sup>2-</sup>	F <sup>-</sup>	
Na <sup>+</sup>	Mg <sup>2+</sup>	Al <sup>3+</sup>		P <sup>3-</sup>	S <sup>2-</sup>	Cl <sup>-</sup>	
K <sup>+</sup>	Ca <sup>2+</sup>			As <sup>3-</sup>	Se <sup>2-</sup>	Br <sup>-</sup>	
Rb <sup>+</sup>	Sr <sup>2+</sup>					I <sup>-</sup>	
Cs <sup>+</sup>	Ba <sup>2+</sup>						

Table 9.2

### Symbols and Names of Common Metal Ions with More than One Ionic Charge

Symbol	Stock name	Classical name
$\text{Cu}^+$	Copper(I) ion	Cuprous ion
$\text{Cu}^{2+}$	Copper(II) ion	Cupric ion
$\text{Fe}^{2+}$	Iron(II) ion	Ferrous ion
$\text{Fe}^{3+}$	Iron(III) ion	Ferric ion
$^*\text{Hg}_2^{2+}$	Mercury(I) ion	Mercurous ion
$\text{Hg}^{2+}$	Mercury(II) ion	Mercuric ion
$\text{Pb}^{2+}$	Lead(II) ion	Plumbous ion
$\text{Pb}^{4+}$	Lead(IV) ion	Plumbic ion
$\text{Sn}^{2+}$	Tin(II) ion	Stannous ion
$\text{Sn}^{4+}$	Tin(IV) ion	Stannic ion
$\text{Cr}^{2+}$	Chromium(II) ion	Chromous ion
$\text{Cr}^{3+}$	Chromium(III) ion	Chromic ion
$\text{Mn}^{2+}$	Manganese(II) ion	Manganous ion
$\text{Mn}^{3+}$	Manganese(III) ion	Manganic ion
$\text{Co}^{2+}$	Cobalt(II) ion	Cobaltous ion
$\text{Co}^{3+}$	Cobalt(III) ion	Cobaltic ion

### Classifying and Naming Cations and Anions

Write the symbol for the ion formed by each element. Classify the ions as cations or anions and name the ion. Potassium and iodine combine to form potassium iodide, an additive to table salt that protects the thyroid gland.

a. potassium   b. iodine   c. sulfur   d. lead, 4 electrons lost

- Name the ions formed by these elements and classify them as anions or cations.
  - selenium
  - barium
  - phosphorus
- How many electrons were lost or gained to form these ions?
  - $\text{Fe}^{3+}$
  - $\text{O}^{2-}$
  - $\text{Cu}^+$

## Polyatomic Ions

See Table 9.3  
p. 257

- some ions consist of more than one atom
- they behave as a unit and carry a charge
- the names of most end in either "-ate" or "-ite"



**Ammonium ion**  
(NH<sub>4</sub><sup>+</sup>)



**Nitrate ion**  
(NO<sub>3</sub><sup>-</sup>)



**Sulfate ion**  
(SO<sub>4</sub><sup>2-</sup>)



**Phosphate ion**  
(PO<sub>4</sub><sup>3-</sup>)

## 9.2: Ionic Compounds

- scientific names (genus & species) are used to avoid confusion
- naming a compound in a way that identifies the chemical composition is a similar process

### Binary Ionic Compounds

- 'binary' means two, therefore a 'binary compound' is a compound composed of two atoms

To name any binary **ionic** compound, place the cation name first followed by the anion name. (positive ion then negative ion)

*Examples:*



*Further Examples:*

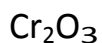


- ALL compounds are considered electrically neutral, therefore the cation Cu must be balancing the anion O
- Oxygen is a Group 6A element, therefore it has a charge of 2-
- In order for Cu to balance this 2- charge, the Cu must be 2+
- Since copper is one of the elements that can exhibit more than one charge, consulting Table 9.2 (p. 255) indicates this cation is named Copper(II)

***This substance is therefore named copper(II) oxide***

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Name the following:



Writing Formulas for Binary Ionic Compounds

- Write the symbol of the cation (+) followed by the symbol of the anion (-).
- Add whatever subscripts are needed to balance the charges

Examples:

-potassium chloride

Periodic Table  
Table 9.2, p. 255

-calcium bromide

-iron (III) oxide

## Compounds with Polyatomic Ions

- write the symbol (formula) for the cation followed by the symbol (formula) for the anion.
- balance the charges

Periodic Table  
Table 9.2, p. 255  
Table 9.3, p. 257

Examples:

-Calcium nitrate

-lithium carbonate

-ammonium dichromate

## 9.3:Molecular Compounds

### Naming Molecular Compounds

- molecular compounds are NOT ionic compounds, therefore we can expect the bonds to be typically covalent and NOT ionic.
- usually non-metal/non-metal compounds

*A prefix in the name of the binary molecular compound indicates how many atoms of an element are present in each molecule of the compound.*

- 'prefix' comes from the Latin 'praefigere' which means 'to fasten before', so it is added to the front of the name of the atom involved.
- convention is 'left to right'

**Table 9.4**

**Prefixes Used in Naming Binary Molecular Compounds**

Prefix	Mono-	Di-	Tri-	Tetra-	Penta-	Hexa-	Hepta-	Octa-	Nona-	Deca-
Number	1	2	3	4	5	6	7	8	9	10

Examples:

CO

N<sub>2</sub>O

SF<sub>6</sub>

Cl<sub>2</sub>O<sub>8</sub>

### Writing Formulas for Molecular Compounds

*Use the prefixes of the names to tell you the number of each element in the compound.*

- convention is 'left to right'

Examples:

silicon carbide

dinitrogen tetraoxide

## 9.4: Acids and Bases

### Naming Acids

*An acid is a substance that contains one or more H<sup>+</sup> ions when dissolved in water.*

1) When the name of the anion ends in '*-ide*', the acid name begins with the prefix '*hydro-*'. The stem of the anion has the suffix '*-ic*' and is followed by the word acid.

EXAMPLE: HCl is named hydrochloric acid

2) When the anion name ends in '*-ite*', the acid is the stem of the anion with the suffix '*-ous*', followed by the word acid.

EXAMPLE: H<sub>2</sub>SO<sub>3</sub> is named sulfurous acid

3) When the anion name ends in '*-ate*', the acid is the stem of the anion with the suffix '*-ic*', followed by the word acid.

EXAMPLE: H<sub>2</sub>SO<sub>4</sub> is named sulfuric acid

### Writing Formula for Acids

- use the rules for writing the names of acids in reverse for determining the formulas.

EXAMPLES:

1) Hydrobromic acid

Since the name follows the pattern 'hydro-' anion stem "-ic", the compound must have been named using Rule 1 and therefore is a binary acid consisting of hydrogen and bromine or HBr

2) Phosphorous acid

The 'ous' ending means that the anion has the 'ite' ending in its name. Using Table 9.3, p. 257, the phosphite ion is PO<sub>3</sub><sup>3-</sup>. Therefore the formula must be H<sub>3</sub>PO<sub>3</sub>

3) Carbonic acid

The 'ic' ending means the anion had the 'ate' ending in its name. Using Table 9.3, p. 257, the carbonate ion is CO<sub>3</sub><sup>2-</sup>. Therefore the formula must be H<sub>2</sub>CO<sub>3</sub>



## Naming and Writing Formulas for Bases

*A base is an ionic compound that produces hydroxide ( $\text{OH}^-$ ) ions when dissolved in water.*

- Bases are named the same way as other ionic compounds, the name of the cation first, followed by the name of the anion.

### EXAMPLES

NaOH is sodium hydroxide

$\text{Ca}(\text{OH})_2$  is calcium hydroxide

aluminum hydroxide is



## 9.5:Laws Governing Formulae and Names