

Introduction to Chemical Names and Formulas

Understanding Simple, Binary Ionic Compounds

Chemical terminology refers to the process of naming chemicals. This assignment focuses on the most basic rules and ideas involved in the naming of compounds.

The simplest compounds contain just two elements. Sodium chloride, NaCl, is an example of a binary compound. Several other examples are listed below.

| | |
|-------------------|-------------------|
| Potassium bromide | KBr |
| Calcium bromide | CaBr ₂ |
| Lithium fluoride | LiF |
| Lithium oxide | Li ₂ O |

In naming binary compounds, follow these rules:

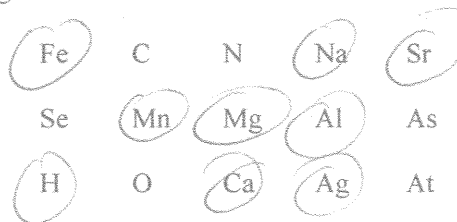
1. The element with the positive ionic charge is written first.
2. The second word is formed by changing the ending of the name of the element to "ide". For example, bromine changes to bromide, fluorine changes to fluoride, and oxygen changes to oxide.

Metals usually have positive ionic charges, or states, while nonmetals (when combined with metals) have negative ionic charges.

Using the rules given above, name the compounds listed below.

1. MgO 1. Magnesium oxide
2. BaS 2. Barium sulfide
3. K₃P 3. Potassium phosphide
4. Na₃N 4. Sodium nitride

5. Below are the symbols for selected elements. Circle the symbols of the elements that usually have positive ionic charges.



Practice Problems

Some transition metals have more than one positive ionic charge. Look at the formulas below.

| | |
|-------------------|--------------------|
| Cu ₂ O | copper(I) oxide |
| CuO | copper(II) oxide |
| FeCl ₂ | iron(II) chloride |
| FeCl ₃ | iron(III) chloride |

Note that roman numerals follow the names of the positive elements. The numerals indicate the ionic charge of the element in the compound.

Transition Metals in Ionic Compounds

Name the following compounds.

6. SnCl₄ 6. Tin (IV) chloride
7. $\overset{-1}{\text{Mn}}\overset{-2 \times 2}{\text{O}_2}$ 7. Manganese (IV) oxide
8. PbS 8. lead (II) sulfide
9. $\overset{-2}{\text{Fe}_2}\overset{-3}{\text{O}_3}$ 9. Iron (III) oxide

Practice Problems

Polyatomic Ions in Ionic Compounds

In nature there are certain elements whose atoms combine to form charged groups called polyatomic ions. These polyatomic ions combine with other ions or other polyatomic ions to form compounds. To name such compounds, you must know the names of the polyatomic ions. Some common polyatomic ions are listed on the following page.

| | | | | | |
|--|----|-----------|------------------|----|-------------------------------------|
| NH ₄ | 1+ | ammonium | SO ₄ | 2- | sulfate |
| H ₃ O | 1+ | hydronium | NO ₃ | 1- | nitrate |
| OH | 1- | hydroxide | CO ₃ | 2- | carbonate |
| C ₂ H ₃ O ₂ | 1- | acetate | HCO ₃ | 1- | hydrogen carbonate (bicarbonate) |
| ClO ₃ | 1- | chlorate | PO ₄ | 3- | phosphate |

Name the following ionic compounds.

- | | | | |
|-------------------------------------|-----------------------------|---|-------------------------------|
| 10. BaSO ₄ | 10. <u>Barium sulfate</u> | 13. NaHCO ₃ | 13. <u>Sodium bicarbonate</u> |
| 11. BaSO ₃ | 11. <u>Barium sulfite</u> | 14. (NH ₄) ₃ PO ₄ | 14. <u>Ammonium phosphate</u> |
| 12. Na ₂ CO ₃ | 12. <u>Sodium carbonate</u> | 15. NH ₄ OH | 15. <u>Ammonium hydroxide</u> |

Some nonmetallic elements may form more than one compound with another nonmetal. The names of these compounds must show the differences between them. Look at the following examples.

| | |
|-------------------------------|-------------------------|
| CO | carbon monoxide |
| CO ₂ | carbon dioxide |
| SO ₂ | sulfur dioxide |
| SO ₃ | sulfur trioxide |
| N ₂ H ₄ | dinitrogen tetrahydride |

In the examples, the prefixes mono-, di-, tri-, and tetra- indicate the number of atoms of the nonmetal in the molecule. These and other prefixes with their meanings are listed below. Note that the prefixes are not used when naming compounds formed between a metal and nonmetal.

| | | | |
|--------|-------|--------|-------|
| mono- | one | hexa- | six |
| di- | two | hepta- | seven |
| tri- | three | octa- | eight |
| tetra- | four | nona- | nine |
| penta- | five | deca- | ten |

| Formula | Charge | Name | Formula | Charge | Name |
|-----------------------------------|--------|-----------------------------------|-----------------------------------|--------|-----------------------------------|
| 16. N ₂ O ₃ | | 16. <u>Dinitrogen trioxide</u> | 19. P ₂ O ₅ | | 19. <u>Diphosphorus pentoxide</u> |
| 17. PCl ₃ | | 17. <u>Phosphorus trichloride</u> | 20. CS ₂ | | 20. <u>Carbon disulfide</u> |
| 18. SiO ₂ | | 18. <u>Silicon dioxide</u> | 21. B ₂ O ₃ | | 21. <u>Diboron trioxide</u> |

Practice Problems

Name or give the formula for the following.

- | | | | |
|-------------------------|--|---|-------------------------------|
| 22. Iron (III) chloride | 22. <u>FeCl₃</u> | 26. Mercury (II) oxide | 26. <u>HgO</u> |
| 23. Silver (I) acetate | 23. <u>AgC₂H₃O₂</u> | 27. NaClO ₃ | 27. <u>Sodium chlorate</u> |
| 24. Ca(OH) ₂ | 24. <u>Calcium hydroxide</u> | 28. (NH ₄) ₂ SO ₄ | 28. <u>Ammonium sulfate</u> |
| 25. CCl ₄ | 25. <u>Carbon tetrachloride</u> | 29. Fe ₂ S ₃ | 29. <u>Iron (III) sulfide</u> |

30. Polyatomics are ions composed of two or more nonmetals. Most (with exception of ammonia) have a negative charge since they are composed of nonmetals. List the ten formulas for the ten polyatomics you are responsible for MEMORIZING:

a. ammonium NH_4^{+1}

e. sulfate SO_4^{-2}

b. hydroxide OH^{-1}

f. phosphate PO_4^{-3}

c. carbonate CO_3^{-2}

g. bicarbonate HCO_3^{-1}

d. nitrate NO_3^{-1}

31. When naming an ionic compound, what element is always named first, the metal or the nonmetal?

Metal

32. What ending is added to the name of the anion (the nonmetal)?

-ide

33. When a transition metal is present in an ionic compound, it must be written with a roman numeral. Why is the roman numeral necessary and what does it represent?

B/c transition metals have variable charges, it's needed to denote the charge in that compound

34. Write the formula of the following ionic compounds. First write out the ions for each element in the compound, and then combine them to make a NEUTRAL compound.

a. calcium chloride



b. magnesium oxide



c. sodium iodide



d. magnesium hydroxide



e. potassium nitrate



f. aluminum chloride



g. iron (II) oxide



h. iron (III) oxide



35. Name the following compounds:

a. MgS

Magnesium sulfide

g. KBr

Potassium bromide

b. Ba_3N_2

Barium nitride

h. Al_2O_3

Aluminum oxide

c. NaI

Sodium iodide

i. SrF_2

Strontium fluoride

d. Li_2S

Lithium sulfide

j. Ca_3P_2

Calcium phosphide

e. CaSO_4

Calcium sulfate

k. $\text{Pb(NO}_3)_2$

Lead (II) nitrate

f. Fe(OH)_3

Iron (III) hydroxide

l. Na_3PO_4

Sodium phosphate

10/10/10

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