

HOW TO DETERMINE A CHEMICAL FORMULA

DOES THE NAME CONTAIN THE WORD “ACID”?

A. Does the name start with “hydro-“? (It’s a binary acid.)

Determine what element is present besides hydrogen, and what ion that element forms.

Formula then follows IONIC RULES below, using hydrogen and the other element.

Examples: Hydrochloric acid is HCl; hydrobromic acid is HBr;

Hydrosulfuric acid is H₂S.

Special case: Hydrocyanic acid is HCN

B. Other acids, containing polyatomic ions:

If the name of the acid ends in “-ic”, then look for a polyatomic ion whose name ends in “-ate”. (If the prefix “per-“ is present, you must include it.)

Follow the IONIC RULES using hydrogen and the polyatomic ion.

If the name of the acid ends in “-ous”, then look for a polyatomic ion whose name ends in “-ite”. (If the prefix “hypo-“ is present, you must include it.)

Follow the IONIC RULES using hydrogen and the polyatomic ion.

DOES THE NAME END IN “-ATE” OR “-ITE”?

C. A polyatomic ion is present. Look up the ion and follow the IONIC RULES below.

NOTE: polyatomic ions with unusual names include dichromate ($-\text{Cr}_2\text{O}_7^{2-}$),

hydrogen carbonate ($-\text{HCO}_3^-$), and hydrogen sulfate ($-\text{HSO}_4^-$).

DOES THE NAME CONTAIN NUMERIC PREFIXES LIKE “MONO-“, “DI-“, or “TRI-“?

D. Follow the rules for COVALENT COMPOUNDS:

An element without a prefix, or with prefix “mono-“, occurs only once (no subscript)

Use subscripts for other elements, as follows:

di- = 2; tri- = 3; tetra- = 4; penta- = 5; hexa- = 6; hepta- = 7; octa- = 8, etc.

NONE OF THE ABOVE APPLY; NAME ENDS IN “-IDE”

E. Special cases: “cyanide” and “hydroxide” are polyatomic ions; follow the IONIC RULES.

F. Ionic compounds of two elements:

Follow the IONIC RULES on the reverse side.

G. These compounds have special names that you should know:

H₂O water NH₃ ammonia CH₄ methane

IONIC RULES are on the REVERSE SIDE

IONIC RULES

Write the positive ion first, then the negative ion:

Positive ions (formed by a metal, or ammonium ion):

Ammonium (NH_4^+) ion is a special case. It has a +1 charge.

Group I metals (Li, Na, K, etc.) have a +1 charge; so does silver (Ag).

Group II metals (Mg, Ca, Sr, etc.) have a +2 charge; so does zinc (Zn).

Aluminum has a +3 charge.

All other metals have different charges in different compounds.

Roman numerals tell you the charge on the metal:

I is +1, II is +2, III is +3, IV is +4, etc.

Examples: iron(II) is Fe^{+2} ; iron(III) is Fe^{+3} ; copper(II) is Cu^{+2} ; etc.

Negative ions:

If the negative ion is formed from a single nonmetallic element (ends in “-ide”):

Fluoride, chloride, bromide, iodide have -1 charge

Oxide, sulfide, selenide, telluride have -2 charge

Nitride and phosphide have -3 charge

Carbide has -4 charge

Look up the chart of polyatomic ions for all other cases.

Write down both ions (positive ion always comes first).

Determine how many times each ion is present by either of these two methods:

1. “Bucket” method: Imagine a bucket of the positive ions and a bucket of the negative ions; your task is to select the smallest combination that produces a neutral molecule (same number of positive and negative charges). The total number of positive charges and the total number of negative charges will each be equal to the “least common multiple” of the positive and negative charges. Example: If ions are +1 and -2, formula is X_2Y , because this is the smallest possible electrically neutral combination. There are a total of two positive charges and two negative charges (two is the “least common multiple” of 1 and 2). Example: If ions are +3 and -2, formula is X_2Y_3 , because this is the smallest possible electrically neutral combination. There are a total of six positive charges and six negative charges (six is the “least common multiple” of 3 and 2).

2. “Criss-cross” method:

The charge on the positive ion becomes a subscript on the negative ion;

the charge on the negative ion (ignoring the minus sign) becomes a subscript on the positive ion.

Now, if the subscripts are the same, or if one is a multiple of the other, you must “reduce to lowest terms”. Example: Ca_2O_2 becomes CaO .

IMPORTANT: If a polyatomic ion occurs more than once, you must put parentheses around it!