Naming Inorganic Acids

Acids are important hydrogen-containing molecular compounds, whose names follow special rules. For the moment, we can define an acid as a compound that in water can produce electrically equivalent numbers of hydrogen ions and anions; e.g.,

$$HCI \rightarrow H^{+} + CI^{-}$$

 $H_{2}SO_{4} \rightarrow 2H^{+} + SO_{4}^{2-}$

In general, the formulas of inorganic acids have H written first, whereas hydrogen-containing inorganic compounds that are not acids do not have H written first.

Acids: HCl, HCN, HNO₃, H₂SO₄, H₃PO₄

Not acids: LiH, BeH₂, NH₃, PH₃

An **oxoacid** is an acid containing hydrogen, oxygen, and another element. The anion produced when an oxoacid dissolves in water is an **oxoanion**. The names of oxoacids follow the following rules:

1. If a central atom can form two different oxoanions, the one with more oxygen atoms is named with the -ate suffix, and the one with fewer oxygen atoms is named with the - ite suffix.

Anion	Name	Anion	Name
NO ₃	nitr <i>ate</i> ion	NO ₂	nitr <i>ite</i> ion
SO ₄ ²⁻	sulf <i>ate</i> ion	SO ₃ ²⁻	sulf <i>ite</i> ion

2. If the anion name ends in -ate, the corresponding acid name ends in -ic.

Anion	Name	Acid	Name
NO ₃	nitr <i>ate</i> ion	HNO ₃	nitr <i>ic</i> acid
SO ₄ ²⁻	sulf <i>ate</i> ion	H ₂ SO ₄	sulfuric acid

3. If the anion name ends in -ite, the corresponding acid name ends in -ous.

Anion	Name	Acid	Name
NO ₂	nitr <i>ite</i> ion	HNO ₂	nitrous acid
SO ₃ ²⁻	sulf <i>ite</i> ion	H ₂ SO ₃	sulfurous acid

4. When a central atom can form three or four oxoacids, both the anions and the oxoacids are distinguished with the prefix *hypo*- and *per*- for the species with the fewest and most oxygen atoms, respectively.

Anion	Name	Acid	Name
CIO ⁻			hypochlorous acid
CIO ₂	chlor <i>ite</i> ion	HCIO ₂	chlorous acid chloric acid
CIO ₃	chlor <i>ate</i> ion	HCIO ₃	chlor <i>ic</i> acid
CIO ₄	<i>per</i> chlor <i>ate</i>	HCIO ₄	<i>per</i> chlor <i>ic</i> acid

Acid anions have H atoms that they can lose as H⁺ in water. The names of these ions add *hydrogen* in front of the name of the corresponding ion that does not have H in it. If the acid anion has two or more hydrogen atoms capable to forming H⁺, the appropriate Greek prefix is used to indicate the number. *Mono*- is omitted if only one acid anion is possible.

Acid Ion	Name
HCO ₃ ⁻	hydrogen carbonate ion
HSO ₄	hydrogen sulfate ion
HPO ₄ ²⁻	monohydrogen phosphate ion
$H_2PO_4^-$	dihydrogen phosphate ion

Binary hydrogen compounds with nonmetals may form H⁺ and an anion when dissolved in water. The acidic solutions are named as if they were molecular acids, using the usual name for the compound itself, replacing *hydrogen* with *hydro*- and the suffix *-ide* with *-ic*. The word *acid* is then added. The formula for such a compound in water is often distinguished from the compound itself by (*aq*), indicating water (aqueous) solution.

Compound	Name	Acid Solution	Name
HCI	hydrogen chloride	HCl(aq)	hydrochloric acid
HCN	hydrogen cyanide	HCN(aq)	hydrocyanic acid
H ₂ S	hydrogen sulfide	H ₂ S(<i>aq</i>)	hydrosulfuric acid

HCN, although not a binary compound, is analogous to the binary hydrogen halides (HCl, HBr, Hl), and so as an acid is named in a similar manner. The name of $H_2S(aq)$ as an acid is slightly irregular in using the full stem name of the element.