What’s the name of the acid responsible for the crisp taste in this drink?

There’s a certain acid that gives many soft drinks their crisp, enjoyable taste.
How do you determine the name and formula of an acid?
• Acids are a group of ionic compounds with unique properties.

• Acids can be defined in several ways.
  • For now, it is enough to know that an acid is a compound that contains one or more hydrogen atoms and produces hydrogen ions when dissolved in water.
• Acids have many uses.

• For example, sulfuric acid is often used to etch circuit boards like the one shown below.
• The chemical formulas of acids are in the general form $H_nX$, where $X$ is a monatomic or polyatomic anion and $n$ is a subscript indicating the number of hydrogen ions that are combined with the anion.
Three rules can help you name an acid with the general formula $H_nX$ dissolved in water.

The naming system depends on the name of the anion (X), in particular the suffix of the anion name.

Each rule deals with an anion with a different suffix: -ide, -ite, and -ate.
Three rules can help you name an acid with the general formula $H_nX$ 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.

Therefore, $HCl$ (X= chloride) is named hydrochloric acid.
Three rules can help you name an acid with the general formula $H_nX$ dissolved in water.

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

Thus, $H_2SO_3$ ($X =$ sulfite) is named sulfurous acid.
• Three rules can help you name an acid with the general formula $H_nX$ dissolved in water.

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

• Thus, $\text{HNO}_3$ ($X = \text{nitrate}$) is named *nitric acid*.
These three rules for naming an acid with the general formula $H_nX$ dissolved in water are summarized in the table below.

<table>
<thead>
<tr>
<th>Anion ending</th>
<th>Example</th>
<th>Acid name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ide</td>
<td>chloride, Cl⁻</td>
<td>hydro-(stem)-ic acid</td>
<td>hydrochloric acid</td>
</tr>
<tr>
<td>-ite</td>
<td>sulfite, SO₃⁻</td>
<td>(stem)-ous acid</td>
<td>sulfurous acid</td>
</tr>
<tr>
<td>-ate</td>
<td>nitrate, NO₃⁻</td>
<td>(stem)-ic acid</td>
<td>nitric acid</td>
</tr>
</tbody>
</table>
An acid that provides the crisp taste in many soft drinks has the formula $\text{H}_3\text{PO}_4$. What’s the name of this acid?

- HBr
- HC$_2$H$_3$O$_2$
- H$_2$SO$_4$
- HNO$_3$
Writing Formulas of Acids

To write the formula for an acid, use the rule for writing the name of the acid in reverse. Then, balance the ionic charges just as you would for any ionic compound.
Writing Formulas of Acids

- For example, consider hydrobromic acid.

  - Rule 1 states: 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.

  - Following Rule 1, hydrobromic acid (hydro-prefix and -ic suffix) must be a combination of hydrogen ion (H\(^+\)) and bromide ion (Br\(^-\)).

  - The formula is HBr.
Writing Formulas of Acids

• How do you write the formula for phosphorous acid?

• Rule 2 states: When the anion name ends in -ite, the acid name is the stem of the anion with the suffix -ous, followed by the word acid.

• Using Rule 1, hydrogen ion and phosphite ion \((PO_3^{3-})\) must be the components of phosphorous acid.

  • You need three hydrogen ions to balance the 3– charge of the phosphite ion.

  • Thus, the formula for phosphorous acid is \(H_3PO_3\).
Finally, what is the formula for sulfuric acid?

- Rule 3 states: When the anion name ends in -ate, the acid name is the stem of the anion with the suffix -ic, followed by the word acid.

- According to Rule 3, sulfuric acid (-ic ending) must be a combination of hydrogen ion and sulfate ion (SO₄²⁻).

- The formula for sulfuric acid is H₂SO₄ because two hydrogen ions are needed to balance the 2– charge of the sulfate anion.
Writing Formulas of Acids

- Many industrial processes, including steel and fertilizer manufacturing, use acids.
- You should become familiar with the names and formulas of common acids such as those listed in the table at right.

<table>
<thead>
<tr>
<th>Common Acids</th>
<th>Name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric acid</td>
<td>HCl</td>
<td>HCl</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>H₂SO₄</td>
<td>H₂SO₄</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>HNO₃</td>
<td>HNO₃</td>
</tr>
<tr>
<td>Acetic or Ethanoic acid</td>
<td>HC₂H₃O₂</td>
<td>HC₂H₃O₂</td>
</tr>
<tr>
<td>Phosphoric acid</td>
<td>H₃PO₄</td>
<td>H₃PO₄</td>
</tr>
<tr>
<td>Carbonic acid</td>
<td>H₂CO₃</td>
<td>H₂CO₃</td>
</tr>
</tbody>
</table>
How do you determine the name and formula of a base?

Bases are ionic substances that contain the polyatomic ion hydroxide (OH-).
Bases are named in the same way as other ionic compounds—the name of the cation is followed by the name of the anion.
The common base sodium hydroxide is used in making cleaners, soap, and paper, as shown in the figure at right.

Sodium hydroxide (NaOH) is composed of sodium cations (Na\(^+\)) and hydroxide anions (OH\(^-\)).
Name the following bases.

a. KOH

b. Fe(OH)$_2$

Write the formulas for the following bases

a. Calcium hydroxide

b. Lead (II) hydroxide
Bases are named like other ionic compounds. To write the formula for a base, write the symbol for the metal cation followed by that of the hydroxide ion. Then, balance the ionic charges.