LEARNING OBJECTIVES

- Define a strong and a weak acid and base.
- Recognize an acid or a base as strong or weak.
- Determine if a salt produces an acidic or a basic solution.

Strong and Weak Acids

Except for their names and formulas, so far we have treated all acids as equals, especially in a chemical reaction. However, acids can be very different in a very important way. Consider HCl(aq). When HCl is dissolved in H₂O, it completely dissociates into H⁺(aq) and Cl⁻(aq) ions; all the HCl molecules become ions:

\[\text{HCl} \overset{100\%}{\rightarrow} \text{H}^+(aq) + \text{Cl}^-(aq)\]

Any acid that dissociates 100% into ions is called a **strong acid**. If it does not dissociate 100%, it is a **weak acid**. HC₂H₃O₂ is an example of a weak acid:

\[\text{HC}_2\text{H}_3\text{O}_2 \overset{\sim 5\%}{\rightarrow} \text{H}^+(aq) + \text{C}_2\text{H}_3\text{O}_2^-(aq)\]

Because this reaction does not go 100% to completion, it is more appropriate to write it as a **reversible reaction**:

\[\text{HC}_2\text{H}_3\text{O}_2 \rightleftharpoons \text{H}^+(aq) + \text{C}_2\text{H}_3\text{O}_2^-(aq)\]

As it turns out, there are very few strong acids, which are given in Table. If an acid is not listed here, it is a weak acid. It may be 1% ionized or 99% ionized, but it is still classified as a weak acid.

<table>
<thead>
<tr>
<th>Acids</th>
<th>Bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl</td>
<td>LiOH</td>
</tr>
<tr>
<td>HBr</td>
<td>NaOH</td>
</tr>
<tr>
<td>HI</td>
<td>KOH</td>
</tr>
<tr>
<td>HNO₃</td>
<td>RbOH</td>
</tr>
<tr>
<td>H₂SO₄</td>
<td>CsOH</td>
</tr>
</tbody>
</table>
### Acids

<table>
<thead>
<tr>
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<th>Bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>HClO₃</td>
<td>Mg(OH)₂</td>
</tr>
<tr>
<td>HClO₄</td>
<td>Ca(OH)₂</td>
</tr>
<tr>
<td></td>
<td>Sr(OH)₂</td>
</tr>
<tr>
<td></td>
<td>Ba(OH)₂</td>
</tr>
</tbody>
</table>

### Strong and Weak Bases

The issue is similar with bases: a **strong base** is a base that is 100% ionized in solution. If it is less than 100% ionized in solution, it is a **weak base**. There are very few strong bases (Table \(\PageIndex{1}\)); any base not listed is a weak base. All strong bases are OH\(^-\) compounds. So a base based on some other mechanism, such as NH₃ (which does not contain OH\(^-\) ions as part of its formula), will be a weak base.

**Example \(\PageIndex{1}\): Identifying Strong and Weak Acids and Bases**

Identify each acid or base as strong or weak.

- **a.** HCl
- **b.** Mg(OH)₂
- **c.** C₅H₅N

**Solution**

- **a.** Because HCl is listed in Table \(\PageIndex{1}\), it is a strong acid.
- **b.** Because Mg(OH)₂ is listed in Table \(\PageIndex{1}\), it is a strong base.
- **c.** The nitrogen in C₅H₅N would act as a proton acceptor and therefore can be considered a base, but because it does not contain an OH compound, it cannot be considered a strong base; it is a weak base.

**Exercise \(\PageIndex{1}\)**

Identify each acid or base as strong or weak.

- **a.** \ce{RbOH}
- **b.** \ce{HNO_2}

**Answer a**  
strong base

**Answer b**  
weak acid
Example 2: Characterizing Base Ionization

Write the balanced chemical equation for the dissociation of Ca(OH)$_2$ and indicate whether it proceeds 100% to products or not.

Solution

This is an ionic compound of Ca$^{2+}$ ions and OH$^{-}$ ions. When an ionic compound dissolves, it separates into its constituent ions:

$$\text{Ca(OH)}_2 \rightarrow \text{Ca}^{2+}(\text{aq}) + 2\text{OH}^- (\text{aq})$$

Because Ca(OH)$_2$ is listed in Table 1, this reaction proceeds 100% to products.

Exercise 2

Write the balanced chemical equation for the dissociation of hydrazoic acid (HN$_3$) and indicate whether it proceeds 100% to products or not.

Answer a

The reaction is as follows:

$$\text{HN}_3 \rightarrow \text{H}^+(\text{aq}) + \text{N}_3^- (\text{aq})$$

It does not proceed 100% to products because hydrazoic acid is not a strong acid.

Summary

Strong acids and bases are 100% ionized in aqueous solution. Weak acids and bases are less than 100% ionized in aqueous solution. Salts of weak acids or bases can affect the acidity or basicity of their aqueous solutions.

Contributions & Attributions

This page was constructed from content via the following contributor(s) and edited (topically or extensively) by the LibreTexts development team to meet platform style, presentation, and quality:

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