

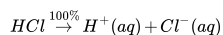
### 12.2.3: Strong and Weak Acids and Bases

#### Learning Objectives

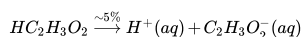
- Define a strong and a weak acid and base.
- Recognize an acid or a base as strong or weak.
- Determine if a salt produces an acidic or a basic solution.

#### Strong and Weak Acids

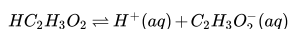
Except for their names and formulas, so far we have treated all acids as equals, especially in a chemical reaction. However, acids can be very different in a very important way. Consider  $\text{HCl(aq)}$ . When  $\text{HCl}$  is dissolved in  $\text{H}_2\text{O}$ , it completely dissociates into  $\text{H}^+(\text{aq})$  and  $\text{Cl}^-(\text{aq})$  ions; all the  $\text{HCl}$  molecules become ions:



Any acid that dissociates 100% into ions is called a **strong acid**. If it does not dissociate 100%, it is a **weak acid**.  $\text{HC}_2\text{H}_3\text{O}_2$  is an example of a weak acid:



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



As it turns out, there are very few strong acids, which are given in Table 12.2.3.1. 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.

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

Table 12.2.3.1: Strong Acids and Bases

Acids	Bases
$\text{HCl}$	$\text{LiOH}$
$\text{HBr}$	$\text{NaOH}$
$\text{HI}$	$\text{KOH}$
$\text{HNO}_3$	$\text{RbOH}$
$\text{H}_2\text{SO}_4$	$\text{CsOH}$
$\text{HClO}_3$	$\text{Mg(OH)}_2$
$\text{HClO}_4$	$\text{Ca(OH)}_2$
	$\text{Sr(OH)}_2$
	$\text{Ba(OH)}_2$

#### 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 12.2.3.1); any base not listed is a weak base. All strong bases are  $\text{OH}^-$  compounds. So a base based on some other mechanism, such as  $\text{NH}_3$  (which does not contain  $\text{OH}^-$  ions as part of its formula), will be a weak base.

#### ✓ Example 12.2.3.1: Identifying Strong and Weak Acids and Bases

Identify each acid or base as strong or weak.

- $\text{HCl}$
- $\text{Mg(OH)}_2$
- $\text{C}_5\text{H}_5\text{N}$

#### Solution

- Because  $\text{HCl}$  is listed in Table 12.2.3.1, it is a strong acid.
- Because  $\text{Mg(OH)}_2$  is listed in Table 12.2.3.1, it is a strong base.
- The nitrogen in  $\text{C}_5\text{H}_5\text{N}$  would act as a proton acceptor and therefore can be considered a base, but because it does not contain an  $\text{OH}$  compound, it cannot be considered a strong base; it is a weak base.

#### ? Exercise 12.2.3.1

Identify each acid or base as strong or weak.

- $\text{RbOH}$
- $\text{HNO}_2$

#### Answer a

strong base

#### Answer b

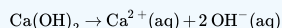
weak acid

#### ✓ Example 12.2.3.2: Characterizing Base Ionization

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

#### Solution

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



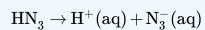
Because  $\text{Ca(OH)}_2$  is listed in Table 12.2.3.1, this reaction proceeds 100% to products.

### ? Exercise 12.2.3.2

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

#### Answer a

The reaction is as follows:



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

#### Key Takeaways

- 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

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