

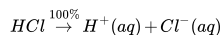
1.11.3: Strong and Weak Acids and Bases

Learning Objectives

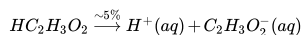
- Define a strong and a weak acid and base.
- Recognize an acid or a base as strong or weak.
- Determine if a salt produces an acidic or a basic solution.

Strong and Weak Acids

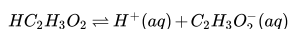
Except for their names and formulas, so far we have treated all acids as equals, especially in a chemical reaction. However, acids can be very different in a very important way. Consider HCl(aq) . When HCl is dissolved in H_2O , it completely dissociates into $\text{H}^+(\text{aq})$ and $\text{Cl}^-(\text{aq})$ ions; all the 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 1.11.3.1. 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 1.11.3.1: Strong Acids and Bases

Acids	Bases
HCl	LiOH
HBr	NaOH
HI	KOH
HNO_3	RbOH
H_2SO_4	CsOH
HClO_3	Mg(OH)_2
HClO_4	Ca(OH)_2
	Sr(OH)_2
	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 1.11.3.1); any base not listed is a weak base. All strong bases are OH^- compounds. So a base based on some other mechanism, such as NH_3 (which does not contain OH^- ions as part of its formula), will be a weak base.

✓ Example 1.11.3.1: Identifying Strong and Weak Acids and Bases

Identify each acid or base as strong or weak.

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

Solution

- Because HCl is listed in Table 1.11.3.1, it is a strong acid.
- Because Mg(OH)_2 is listed in Table 1.11.3.1, 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 OH compound, it cannot be considered a strong base; it is a weak base.

? Exercise 1.11.3.1

Identify each acid or base as strong or weak.

- RbOH
- HNO_2

Answer a

strong base

Answer b

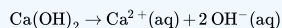
weak acid

✓ Example 1.11.3.2: 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:



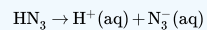
Because Ca(OH)_2 is listed in Table 1.11.3.1, this reaction proceeds 100% to products.

? Exercise 1.11.3.2

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:



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.

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