

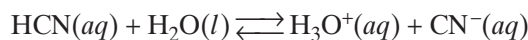
TABLE 3 Common Aqueous Acids

Strong acids	Weak acids
$\text{HI} + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{I}^-$	$\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{SO}_4^{2-}$
$\text{HClO}_4 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{ClO}_4^-$	$\text{H}_3\text{PO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{H}_2\text{PO}_4^-$
$\text{HBr} + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{Br}^-$	$\text{HF} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{F}^-$
$\text{HCl} + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$	$\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{CH}_3\text{COO}^-$
$\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{HSO}_4^-$	$\text{H}_2\text{CO}_3 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{HCO}_3^-$
$\text{HClO}_3 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{ClO}_3^-$	$\text{H}_2\text{S} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{HS}^-$
	$\text{HCN} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{CN}^-$
	$\text{HCO}_3^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{CO}_3^{2-}$

Strength of Acids

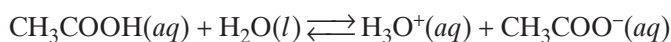
A **strong acid** is one that ionizes completely in aqueous solution. A strong acid is a strong electrolyte. Perchloric acid, HClO_4 , hydrochloric acid, HCl , and nitric acid, HNO_3 , are examples of strong acids. In water, 100% of the acid molecules are ionized. The strength of an acid depends on the polarity of the bond between hydrogen and the element to which it is bonded and the ease with which that bond can be broken. Acid strength increases with increasing polarity and decreasing bond energy.

An acid that releases few hydrogen ions in aqueous solution is a **weak acid**. The aqueous solution of a weak acid contains hydronium ions, anions, and dissolved acid molecules. Hydrocyanic acid is an example of a weak acid. In aqueous solution, both the ionization of HCN and the reverse reaction occur simultaneously. In a 1 M solution of HCN there will be only two H^+ ions and two CN^- ions out of 100,000 molecules. The other 99,998 molecules remain as HCN .



Common aqueous acids are listed in **Table 3**. Each strong acid ionizes completely in aqueous solution to give up one hydrogen ion per molecule. Notice that the number of hydrogen atoms in the formula does not indicate acid strength. Molecules with multiple hydrogen atoms may not readily give up each hydrogen. The fact that phosphoric acid has three hydrogen atoms per molecule does not mean that it is a strong acid. None of these ionize completely in solution, so phosphoric acid is weak.

Organic acids, which contain the acidic carboxyl group $-\text{COOH}$, are generally weak acids. For example, acetic acid, CH_3COOH , ionizes slightly in water to give hydronium ions and acetate ions, CH_3COO^- .



A molecule of acetic acid contains four hydrogen atoms. However, only one of the hydrogen atoms is ionizable. The hydrogen atom in the