**Strong and Weak Acids - Introduction**

Acids are classified as either strong or weak, based on how frequently the proton within the acid is donated in [water](https://www.ck12.org/c/biology/water?referrer=crossref). A **strong acid** is an acid which is completely ionized in an aqueous [solution](https://www.ck12.org/c/physical-science/solution?referrer=crossref) – all acid molecules donate their proton. Hydrogen chloride (HCl) ionizes completely into hydrogen ions and chloride ions in [water](https://www.ck12.org/c/biology/water?referrer=crossref).

HCl(g) + H2O(aq) → H3O+(aq) + Cl−(aq)

A **weak acid** is an acid that ionizes only slightly in an aqueous [solution](https://www.ck12.org/c/physical-science/solution?referrer=crossref). Acetic acid (found in vinegar) is a very common weak acid. Its ionization is shown below.

CH3COOH(aq) + H2O(aq)  **⇄** H3O+(aq) + CH3COO−(aq)

The ionization of acetic acid is incomplete, and so an equilibrium is established, and the equation is shown with a double arrow. The extent of ionization of weak acids varies, but is generally less than 10%. For example, a 0.10 M [solution](https://www.ck12.org/c/physical-science/solution?referrer=crossref) of acetic acid (vinegar) is only about 1.3% ionized, meaning that the equilibrium strongly favours the reactants.

Acids ionize to yield the H3O+ [ion](https://www.ck12.org/c/physical-science/ion?referrer=crossref) and a conjugate [base](https://www.ck12.org/c/physical-science/base?referrer=crossref). Because HCl is a strong acid, its conjugate base (Cl−) is extremely weak. The chloride [ion](https://www.ck12.org/c/physical-science/ion?referrer=crossref) is incapable of accepting the H+ [ion](https://www.ck12.org/c/physical-science/ion?referrer=crossref) and becoming HCl again. This is why strong acids do not form equilibriums, their conjugate base is so weak it does not accept protons to any measurable degree. In general, the stronger the acid, the weaker its conjugate [base](https://www.ck12.org/c/physical-science/base?referrer=crossref). Likewise, the weaker the acid, the stronger its conjugate base.

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| **Relative Strengths of Acids and their Conjugate Bases** | |
| **Acid** | **Conjugate**[**Base**](https://www.ck12.org/c/physical-science/base?referrer=crossref) |
| ***Strong Acids*** |  |
| HCl (hydrochloric acid) (strongest) | Cl− (chloride ion) (weakest) |
| H2SO4 (sulfuric acid) | HSO4− (hydrogen sulfate ion) |
| HNO3 (nitric acid) | NO3− (nitrate ion) |
| ***Weak Acids*** |  |
| CH3COOH (acetic acid) | CH3COO− (acetate ion) |
| H2CO3 (carbonic acid) | HCO3− (hydrogen carbonate ion) |
| HCN (hydrocyanic acid) (weakest) | CN− (cyanide ion) (strongest) |

Since most acids are weak acids and establish an equilibrium with their conjugate base, the equilibrium can be described by an equilibrium constant. In the case of Acids and Bases, the equilibrium constants are called Ka – for describing the euilibrioum position of a weak acids, and Kb – for describing the equilibrium position of weak bases. The values of the Ka and Kb give an exact measure of how strong or weak and acid/base is. The lower the Ka or Kb, the weaker the acid or base.

Because strong acids and bases dissociate readily they react quickly with water. This can prove dangerous, as these reactions are often exothermic, so the resulting solution can get very hot very quickly. For this reason it is recommended that when diluting strong acids and bases to add a small amount of acids (or bases) to water, rather than adding water to the acid or base.

Because strong acids and bases dissociate readily the resultant solution (assuming it is reasonably concentrated) will contain a significant number of ions, and therefore conduct an electric current readily. At the same concentration, a solution of strong acid will always be more electrically conductive than a weak acid.

**QUESTIONS**

1. When HCl dissolves in water,
   1. the molecule reacts with water
   2. an equilibrium forms with water
   3. 100% ionization occurs
   4. partial ionization occurs
2. When acetic acid dissolves in water,
   1. the molecule reacts with water
   2. an equilibrium forms with water
   3. 100% ionization occurs
   4. partial ionization occurs
3. Weak acids ionize to form
   1. protons and anions
   2. protons and a conjugate base
   3. protons and a conjugate acid
   4. a conjugate acid and a conjugate base
4. All of the acids below are strong acids except
   1. nitric acid
   2. hydrochloric acid
   3. phosphoric acid
   4. sulfuric acid
5. True/False: Some weak acids are found in food and beverages.
6. True/False: A double arrow is used to indicate ionization of strong acids.
7. True/False: Each successive ionization for a polyprotic acid is less likely than the previous one.
8. Why is it important to know if an acid is strong or weak?