

Acids Bases and Salts



The Chemistry of Acids and Bases

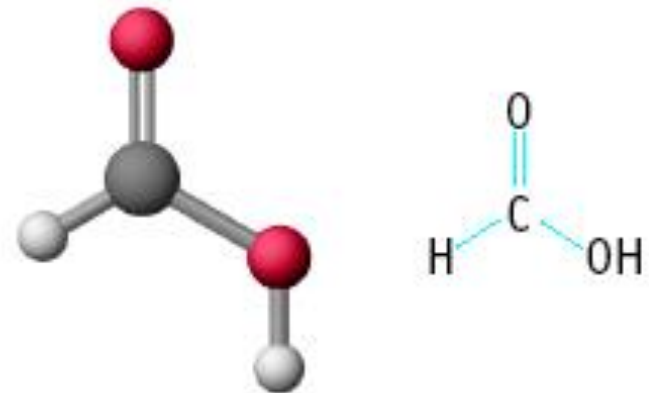


Are Called Electrolytes

Acid and Bases



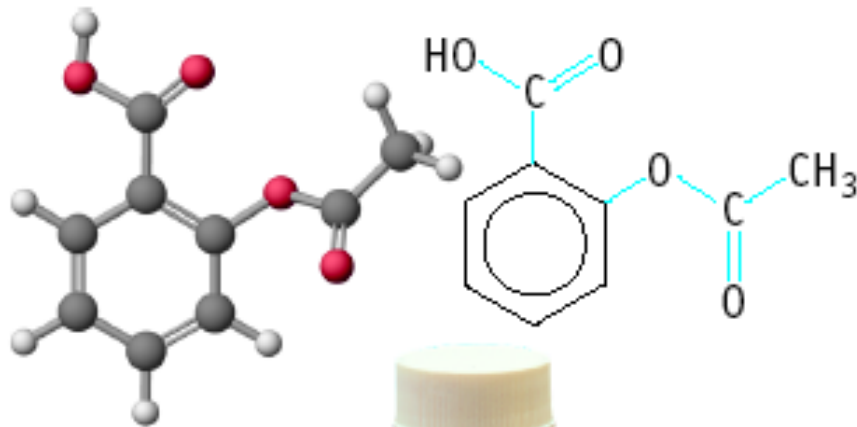
▲ The tartness of lemons and oranges comes from the weak acid citric acid. The acid is found widely in nature and in many consumer products.
(Charles D. Winters)



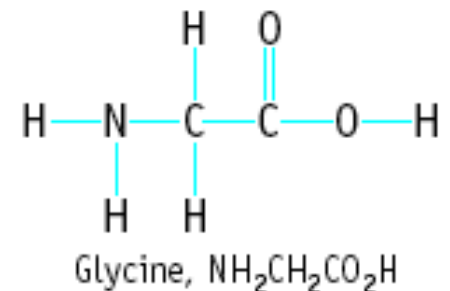
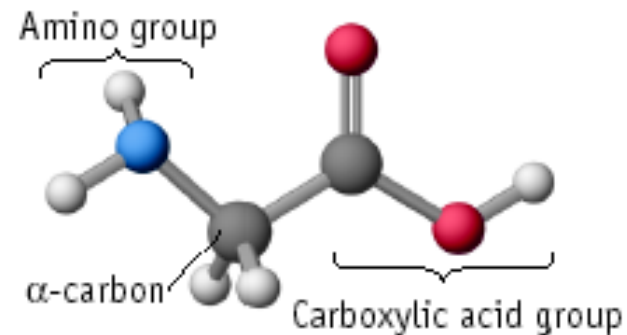
▲ The sting of ants is due to the weak acid formic acid, HCO₂H.
(Gallo Images/@ CORBIS)



Acid and Bases



▲ Aspirin is a weak acid that has been used as an analgesic for over 100 years.
(Charles D. Winters)

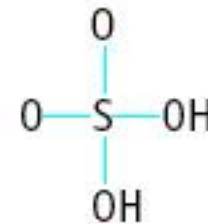


▲ Glycine is representative of the amino acids that are the basis of proteins. The $-\text{CO}_2\text{H}$ group is the acid portion of the molecule, and the $-\text{NH}_2$ group is the basic portion. (Charles D. Winters)

Acid and Bases

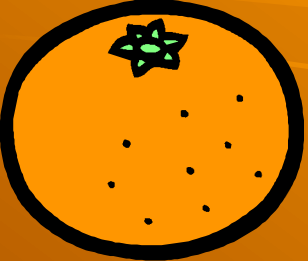


▲ Caffeine is a well known stimulant and a weak base.
(Charles D. Winters)



▲ A sea slug excretes the strong acid sulfuric acid in self-defense. (Sharksong/M. Kazmers/Dembinski Photo Associates)





Acids

Have a sour taste. Vinegar is a solution of acetic acid.
Citrus fruits contain citric acid.

React with certain metals to produce hydrogen gas.

React with carbonates and bicarbonates to produce
carbon dioxide gas



Acids

- ◆ **Compounds that contain hydrogen and releases the hydrogen ions when it is dissolved in water**

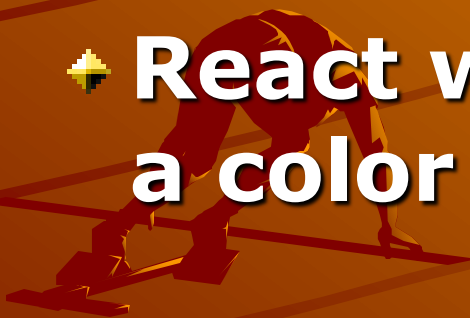


Properties of Acids

- ◆ **Taste sour**
 - Never taste acids in the science lab!
- ◆ **Electrolytes**
- ◆ **Corrosive**
- ◆ **Produce H^+ ions in water**
- ◆ **H^+ and the H_2O combine to form the H_3O^+ ion (Hydronium Ion)**
 - ◆ $H_2O + H^+ \rightarrow H_3O^+$
- ◆ **Any solution that contains H_3O^+ is and Acid**

Acid Strength

- ✦ **The strength of an acid depends on how completely the compound ionizes in an water**
 - ✦ **(how many H^+ are released)**
- ✦ **React with indicators to produce a color change**



Common Acids

- ✦ **Foods – butter, vinegar, lemon juice, carbonated beverages**
- ✦ **Gastric juice – Stomach acid**
- ✦ **Car batteries – Sulfuric acid**
- ✦ **Muriatic Acid – Hydrochloric Acid**
- ✦ **Sulfuric Acid**
- ✦ **H₂SO₄ – Most widely used chemical in the world**
 - Batteries
 - Fertilizer
 - Dehydrating agent

Acids

- ◆ **Phosphoric Acid**



- ◆ **Used in making fertilizer**

- ◆ **Used in making soft drinks**

- ◆ **Used in making detergents**

- ◆ **Causes water pollution by increasing the algae growing in an area**

Acids

- ◆ **Nitric Acid**
- ◆ **HNO_3**
- ◆ **Used in making explosives**
- ◆ **Manufacturing of fertilizers**



Hydrochloric Acid

- ◆ **HCl**
- ◆ **A colorless gas dissolved in water**
- ◆ **Muriatic acid used to clean surfaces and remove corrosion**
- ◆ **Used to remove impurities off metals (Pickling)**
- ◆ **The Acid your stomach uses to begin breaking down food**

Naming Acids

- ✦ **Composed of two elements, hydrogen and a nonmetal.**
- ✦ **Named with the prefix hydro, the name of the nonmetal, and the suffix ic**
 - HCl is hydrochloric acid
 - HBr is hydrobromic acid
 - HF is hydrofluoric acid
- ✦ **When naming a poly atomic acid the non oxygen part of the poly atomic ion is used to name the acid and ic is added**
 - HNO_3 is nitric acid
 - H_2CO_3 is carbonic acid
 - H_2SO_4 is Sulfuric acid
 - H_3PO_4 is Phosphoric acid

Organic acids

- ◆ Organic acids do not follow these rules for naming an acid
- ◆ CH_3COOH or $\text{HC}_2\text{H}_3\text{O}_2$ is acetic acid
- ◆ Citric Acid



Ionization of acids

- ✦ When water ionizes it breaks up into hydronium and hydroxide
$$2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$$
- ✦ If there are more H_3O^+ Ions present in a solution it is an acid solution
- ✦ If there are more OH^- ions present than H_3O^+ then the solution is a Base
- ✦ When there is the same number of H_3O^+ as OH^- the solution is neutral
- ✦ $\text{H}_3\text{O}^+ + \text{OH}^- \rightarrow 2\text{H}_2\text{O}$

Bases

- ✦ **Compounds that contain hydroxide and release OH^- in a solution by dissociation**
- ✦ **Properties of Bases**
 - Bitter
 - ✦ Don't taste bases in the science lab either!
 - Slippery to the touch
 - Dissolve fats, oils and proteins;
 - Produce OH^- in water
 - React with acid to neutralize the solution
 - Electrolytes
 - React with indicators

Common bases

✦ Soaps

✦ Nonmetal base $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{OH}$

✦ Metallic Hydroxides

most bases are metal hydroxides

✦ Sodium Hydroxide NaOH Caustic Soda (Drain Cleaner)

✦ Calcium Hydroxide $\text{Ca}(\text{OH})_2$ Caustic

✦ Lime (Used in Plaster)

✦ Magnesium hydroxide $\text{Mg}(\text{OH})_2$

Ionization

✦ When you put a acid compound in water it ionizes



Dissociation

- ◆ Base compounds dissociate when they are placed in water



Acid anhydrids

◆ A compound that forms and acid with the water

◆ Non metal oxides

– $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$ which will further ionize into $\text{H}^+ + \text{CO}_3^{-2}$

– $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ which further ionizes

Base anhydrids

◆ A compound that forms a base when it combines with H_2O

◆ Metal Oxides

– $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$ which will further dissociates into Na^+ & OH^-



Strength of Acids or Bases

- ✦ The strength of an acid depends on how completely it will ionize in H_2O
- ✦ $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$
- ✦ Hydrochloric acid ionizes completely in water
- ✦ The strength of a base depends on how completely it dissociates in water
 $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$
- ✦ Since the water is only involved in breaking apart the ions it is not expressed in the equation

✦ Give the appropriate name or formula for the following acids.

- Hydroiodic Acid
- HF
- Hydrobromic Acid
- Nitric Acid
- H_2SO_4

✦ Describe each of the acids in question #1 as either binary or ternary.

✦ Give the appropriate name or formula for the following bases.

- Sodium Hydroxide
- $\text{Ba}(\text{OH})_2$
- $\text{Fe}(\text{OH})_3$
- Copper (II) Hydroxide
- Tin (IV) Hydroxide

pH Scale

- ✦ The strength of an acid or a base is expressed in pH (Stands for the negative log of the H^+ concentration)
- ✦ An acid has a high H^+ concentration, and so it has a low pH
- ✦ An acid pH is form 0 - 7
- ✦ A base has a low H^+ concentration so it has a high pH
- ✦ A Base pH range from 7 - 14
- ✦ A neutral solution is 7

Indicators

- ◆ **Indicators turn color in acid or basic solutions**
 - **Litmus paper**
 - ◆ **blue turn red in acid**
 - ◆ **red turn blue in a base**
 - **Phenolphthalein turns pink in a base and clear in an acid**
 - **Bromothymol blue is blue in a base and clear in an acid**
 - **Red cabbage juice and tea change color in an acid or a base**

Neutralization

- ◆ Salt and water is the result of mixing an acid and a base together
- ◆ $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$, Salt and water is the result of neutralization
- ◆ Salts are a ionic compound of a metal and a nonmetal
 NaCl , BaSO_4 , CaCO_3 , MgSO_4

Salts

✦ Metal and a nonmetal ionically combined.

– NaCl

– BaCO₃

– AgCl

– MgSO₄

Soaps and Detergents

- ◆ **Soaps are organic salts made from a fat or oil combined to a positive ion**
- ◆ **The process of making soap is saponification**
- ◆ **Detergents are made from a hydrocarbon and a negative ion**

Organic Acids and Esters

- ◆ Esters are formed from combining an organic acid with an alcohol
- ◆ Ester form naturally in nature to give fragrance (Which is involved in taste)



Our Acid, Base, Salt Sensor

◆ Your Tongue

- Sour – Acids
- Bitter – Bases
- Salty – Salts
- Sweet – Sugars

