

Acids and Bases

- Definition of acid and base (several definitions)
 - Arrhenius: acid increases H^+ concentration in aqueous solution, base increases concentration of OH^- in solution.
 - H^+ is H_3O^+ in water
 - Bronsted-Lowry: Acid is a proton donor, base is a proton acceptor



- Lewis: Acid is an electron pair donor, base is electron pair acceptor

Common Acids and Bases and Strength

- “Strength” refers to extent of dissociation

- Strong = “complete” dissociation
- Weak = “partial” dissociation

- Chemical Equilibrium

- Describes extent of a reaction
- Thermodynamics
- Example: acetic acid

Table 7.1 Some Familiar Acids

Name	Formula	Acid Strength	Common Uses/Notes
Sulfuric acid	H_2SO_4	Strong	Battery acid; ore processing, fertilizer manufacturing, oil refining; extremely corrosive
Nitric acid	HNO_3	Strong	Manufacture of fertilizers, explosives
Hydrochloric acid	HCl	Strong	Cleaning of metals, bricks; removing scale from boilers
Phosphoric acid	H_3PO_4	Moderate	Manufacture of fertilizers; colas; rust removers
Hydrogen sulfate ion	HSO_4^-	Moderate	Toilet bowl cleaners ($NaHSO_4$)
Lactic acid	$CH_3CHOHCOOH$	Weak	Yogurt; acidulant (food additive to increase tartness); lotion additive
Acetic acid	CH_3COOH	Weak	Vinegar; acidulant
Carbonic acid	H_2CO_3	Weak	Unstable; formed in aqueous CO_2
Boric acid	H_3BO_3	Very weak	Antiseptic eye wash, roach poison
Hydrocyanic acid	HCN	Very weak	Plastics manufacture; extremely toxic

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Table 7.2 Common Bases

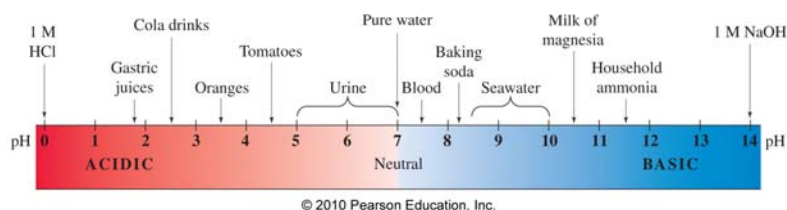
Name	Formula	Classification	Common Uses/Notes
Sodium hydroxide	$NaOH$	Strong	Acid neutralization; soap making; dehorning calves
Potassium hydroxide	KOH	Strong	Making liquid soaps; absorbing CO_2
Lithium hydroxide	$LiOH$	Strong	Alkaline storage batteries
Calcium hydroxide	$Ca(OH)_2$	Strong*	Plaster; cement; water purification; agriculture
Magnesium hydroxide	$Mg(OH)_2$	Strong*	Antacid, laxative
Ammonia	NH_3	Weak	Fertilizer, household cleansers

*Although these bases are classified as strong, they are not very soluble. Calcium hydroxide is only slightly soluble in water, and magnesium hydroxide is practically insoluble.

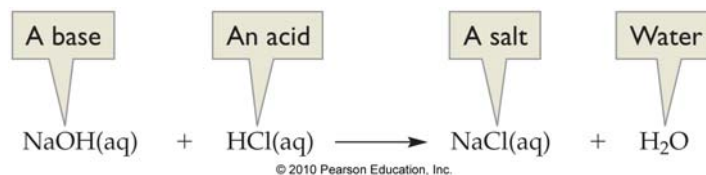
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Quantifying Acid Concentration

- Hydronium concentration can range over large span
- pH = measure of hydronium concentration in water
 $\text{pH} = -\log[\text{H}^+]$ (what's a log tell us?)

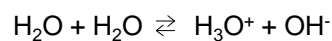


- Acid/base/neutral solutions
- Neutralization reactions and conjugate acid/base pairs



Acid/Base Character of Water

- Autoprotolysis: aka “self-ionization”



- This reaction occurs whenever water is present, but only to a small extent
- Equilibrium constant for water is very small

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$