Ch 17 — Part 1

Chemistry and Chemical Reactivity
6th Edition

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CHAPTER 17

Principles of Reactivity: Chemistry of Acids and Bases

Lectures written by John Kotz

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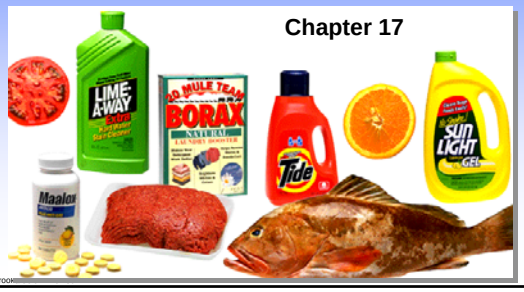
The Chemistry of Acids and Bases

Chapter 17



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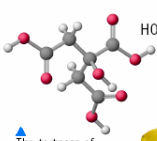
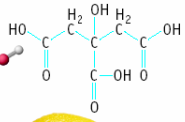
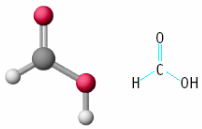
Acid and Bases







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, HCO_2H. *(Gallo Images/@ CORBIS)*

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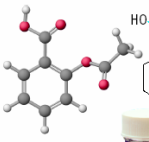
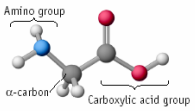
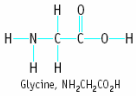
Acid and Bases





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



Glycine, $NH_2CH_2CO_2H$

Glycine is representative of the amino acids that are the basis of proteins. The $-CO_2H$ group is the acid portion of the molecule, and the $-NH_2$ group is the basic portion. *(Charles D. Winters)*

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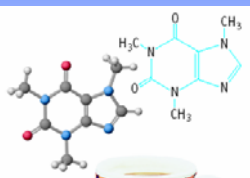
Acid and Bases



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)*

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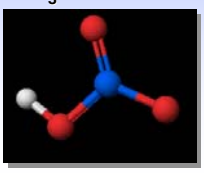
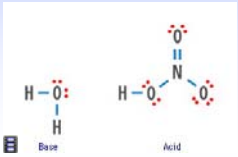
Strong and Weak Acids/Bases

- **Generally divide acids and bases into STRONG or WEAK ones.**

STRONG ACID: $HNO_3(aq) + H_2O(liq) \rightarrow H_3O^+(aq) + NO_3^-(aq)$

HNO_3 is about 100% dissociated in water.





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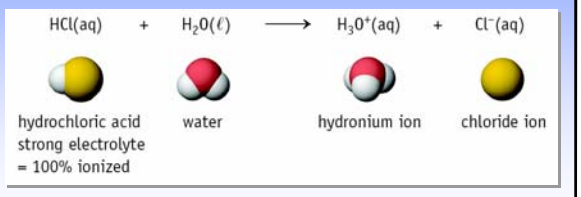
Strong and Weak Acids/Bases

HNO_3, HCl, H_2SO_4 and $HClO_4$ are among the only known strong acids.



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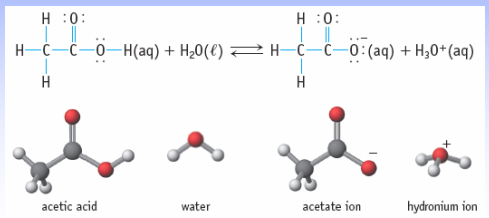
Strong and Weak Acids/Bases

- Weak acids are much less than 100% ionized in water.

One of the best known is acetic acid = CH_3CO_2H



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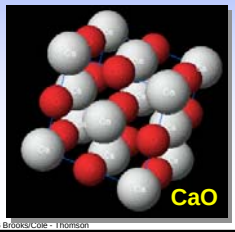
Strong and Weak Acids/Bases

- **Strong Base:** 100% dissociated in water.

NaOH(aq) ---> Na^+(aq) + OH^-(aq)



Other common strong bases include KOH and $Ca(OH)_2$.

CaO (lime) + H_2O -->

$Ca(OH)_2$ (slaked lime)

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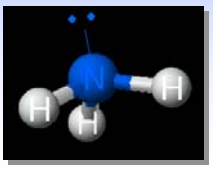
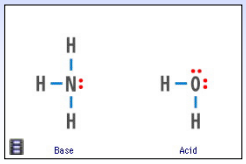
Strong and Weak Acids/Bases

- **Weak base:** less than 100% ionized in water

One of the best known weak bases is **ammonia**

$NH_3(aq) + H_2O(liq) \leftrightarrows NH_4^+(aq) + OH^-(aq)$





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ACID-BASE THEORIES

- The most general theory for common aqueous acids and bases is the BRØNSTED - LOWRY theory
- ACIDS DONATE H^+ IONS
- BASES ACCEPT H^+ IONS

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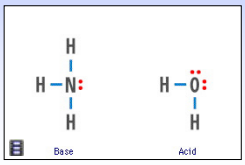
ACID-BASE THEORIES

The Brønsted definition means NH_3 is a **BASE** in water — and water is itself an **ACID**

NH_3	+	H_2O	⇌	NH_4^+	+	OH^-
Base		Acid		Acid		Base



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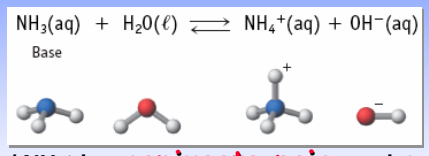
ACID-BASE THEORIES

NH_3 is a **BASE** in water — and water is itself an **ACID**



NH_3 / NH_4^+ is a **conjugate pair** — related by the gain or loss of H^+

Every acid has a conjugate base - and vice-versa.

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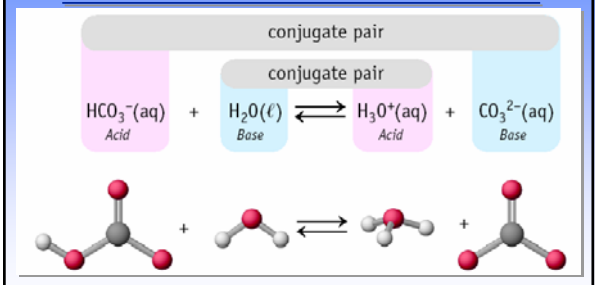
Conjugate Pairs



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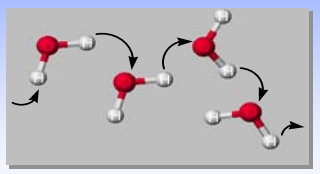
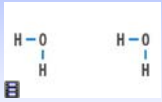
More About Water

H_2O can function as both an ACID and a BASE.

In pure water there can be **AUTOIONIZATION**





Equilibrium constant for autoion = K_w

$K_w = [H_3O^+][OH^-] =$ **1.00×10^{-14}** at 25 °C

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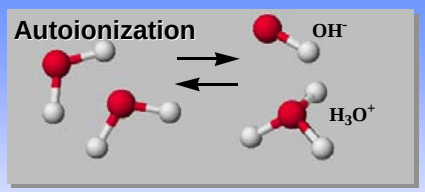
More About Water



$K_w = [H_3O^+][OH^-] = 1.00 \times 10^{-14}$ at 25 °C

In a **neutral** solution $[H_3O^+] = [OH^-]$

so $K_w = [H_3O^+]^2 = [OH^-]^2$

and so $[H_3O^+] = [OH^-] = 1.00 \times 10^{-7}$ M

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