Introduction to Acids and Bases

Notes 14 - Properties of Acids and Bases

- Acids taste sour. Bases taste bitter and feel slippery.
- Acids and bases are conductors of electricity.
- Acids and bases can be identified by their reactions with some metals and metal carbonates.

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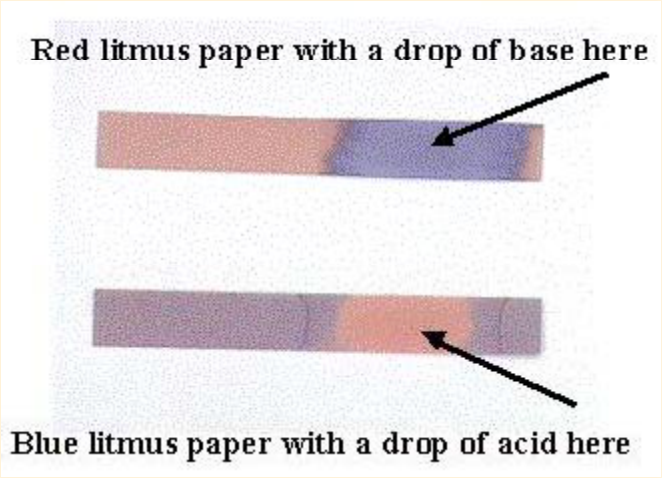
Properties of Acids and Bases (cont.)

- Acids turn blue litmus red.
- Bases turn red litmus blue.
- Magnesium and zinc react with acids to produce hydrogen gas.
- Geologists identify limestone because it produces bubbles of carbon dioxide when exposed to hydrochloric acid.



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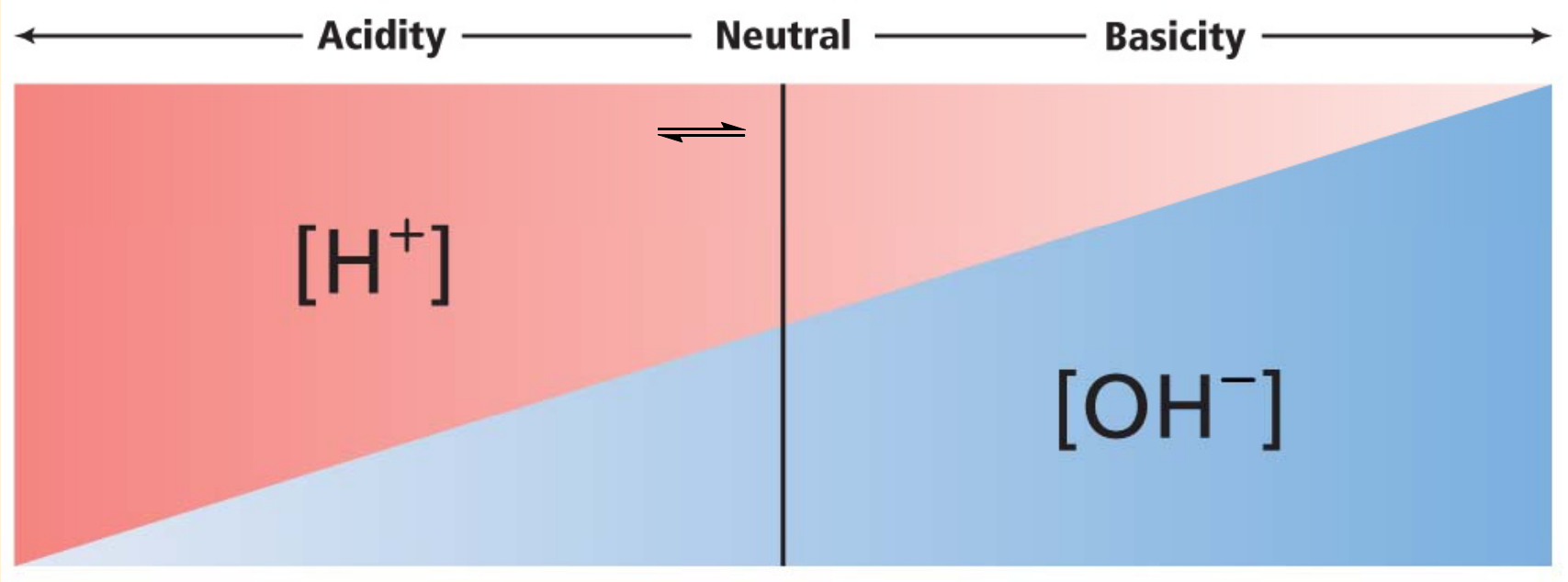
Properties of Acids and Bases (cont.)

- All water solutions contain hydrogen ions (H^+) and hydroxide ions (OH^-).



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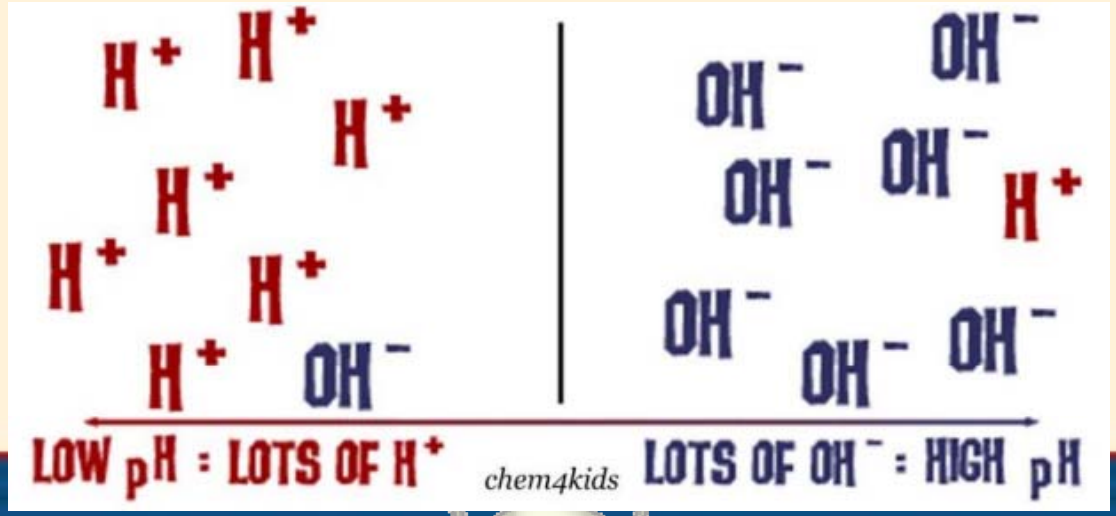
Properties of Acids and Bases (cont.)

- An acidic solution contains more hydrogen ions than hydroxide ions.
- A basic solution contains more hydroxide ions than hydrogen ions.



Introduction to Acids and Bases

The Arrhenius Model

The **Arrhenius model** states that an acid is a substance that contains hydrogen and ionizes to produce hydrogen ions in aqueous solution, and a base is a substance that contains a hydroxide group and dissociates to produce a hydroxide ion in solution.

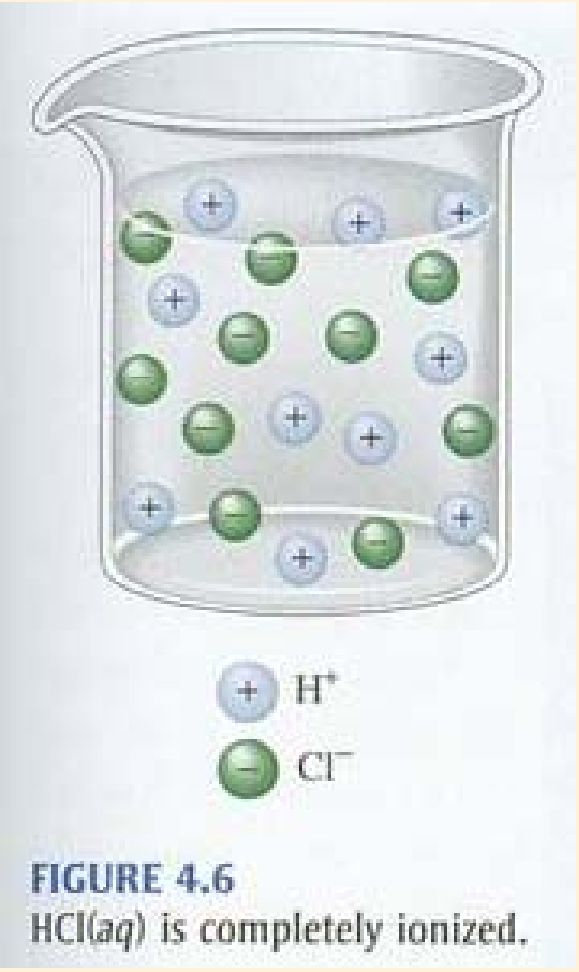


FIGURE 4.6
HCl(*aq*) is completely ionized.

Introduction to Acids and Bases

The Arrhenius Model (cont.)

- Arrhenius acids and bases
  - HCl ionizes to produce H^+ ions.
  - $HCl(g) \rightarrow H^+(aq) + Cl^-(aq)$
  - NaOH dissociates to produce OH^- ions.
  - $NaOH(s) \rightarrow Na^+(aq) + OH^-(aq)$
  - Some solutions produce hydroxide ions even though they do not contain a hydroxide group.

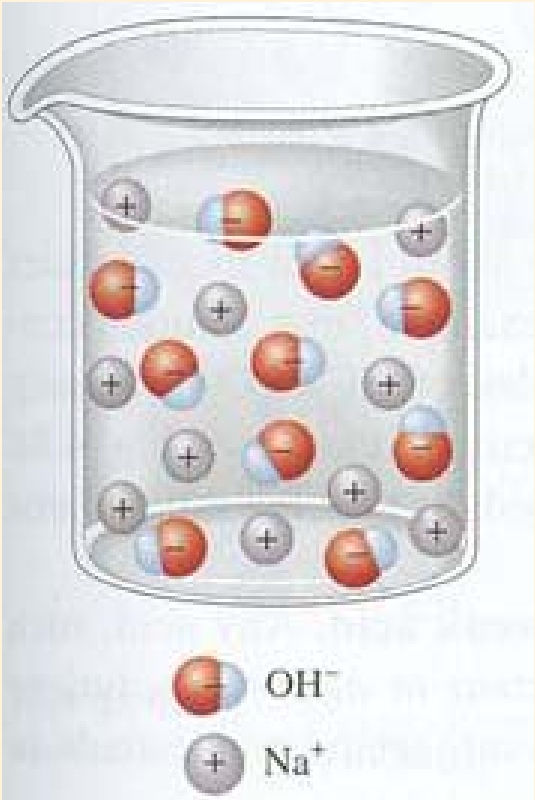


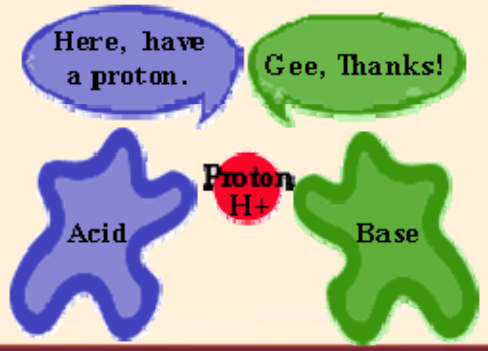
FIGURE 4.7
An aqueous solution of sodium hydroxide.

Introduction to Acids and Bases

The Brønsted-Lowry Model

- The **Brønsted-Lowry Model** of acids and bases states that an acid is a hydrogen ion (proton) donor, and a base is a hydrogen ion (proton) acceptor.

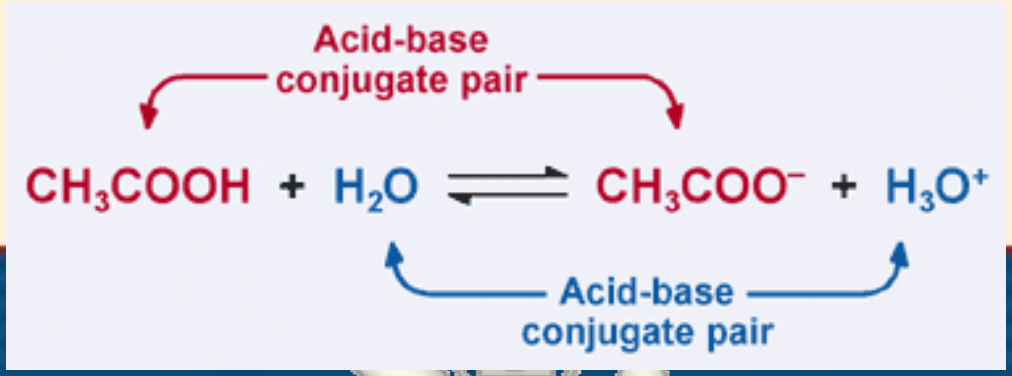
- The Brønsted-Lowry Model is a more inclusive model of acids and bases.



Introduction to Acids and Bases

The Brønsted-Lowry Model (cont.)

- A **conjugate acid** is the species produced when a base accepts a hydrogen ion.
- A **conjugate base** is the species produced when an acid donates a hydrogen ion.
- A **conjugate acid-base pair** consists of two substances related to each other by donating and accepting a single hydrogen ion.



Introduction to Acids and Bases

The Brønsted-Lowry Model (cont.)

- Hydrogen fluoride—a Brønsted-Lowry acid
  - $HF(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + F^-(aq)$
  - HF = acid, H_2O = base, H_3O^+ = conjugate acid, F^- = conjugate base

Introduction to Acids and Bases

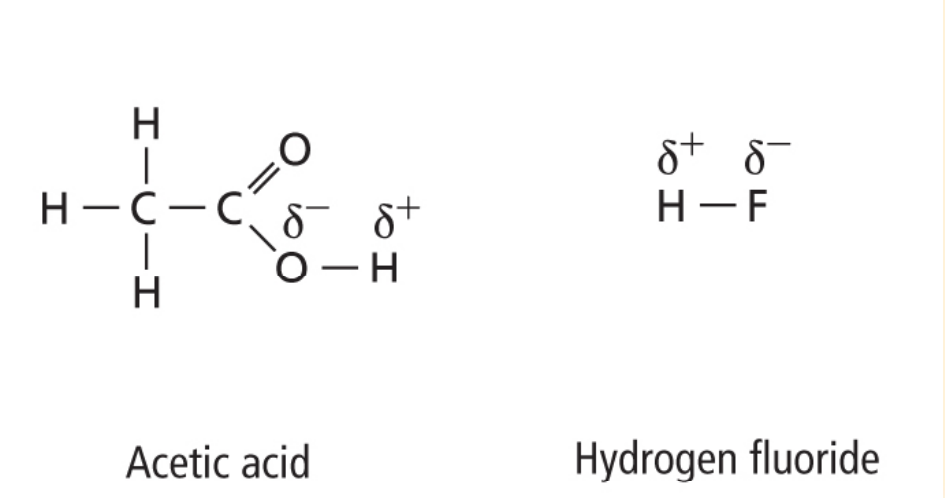
The Brønsted-Lowry Model (cont.)

- Ammonia— Brønsted-Lowry base
  - $NH_3(aq) + H_2O(l) \leftrightarrow NH_4^+(aq) + OH^-(aq)$
- Water and other substances that can act as acids or bases are called **amphoteric**.

Introduction to Acids and Bases

Monoprotic and Polyprotic Acids

- An acid that can donate only one hydrogen ion is a monoprotic acid.
- Only ionizable hydrogen atoms can be donated.



Introduction to Acids and Bases

Monoprotic and Polyprotic Acids

- Acids that can donate more than one hydrogen ion are polyprotic acids.

Table 18.1 Some Common Acids and Their Conjugate Bases

Acid		Congugate Base	
Name	Formula	Name	Formula
Hydrochloric acid	HCl	Chloride ion	Cl^-
Nitric acid	HNO_3	Nitrate ion	NO_3^-
Sulfuric acid	H_2SO_4	Hydrogen sulfate ion	HSO_4^-
Hydrogen sulfate ion	HSO_4^-	Sulfate ion	SO_4^{2-}
Hydrofluoric acid	HF	Fluoride ion	F^-
Hydrocyanic acid	HCN	Cyanide	CN^-
Acetic acid	$HC_2H_3O_2$	Acetate ion	$C_2H_3O_2^-$
Phosphoric acid	H_3PO_4	Dihydrogen phosphate ion	$H_2PO_4^-$
Dihydrogen phosphate ion	$H_2PO_4^-$	Hydrogen phosphate ion	HPO_4^{2-}
Hydrogen phosphate ion	HPO_4^{2-}	Phosphate ion	PO_4^{3-}
Carbonic acid	H_2CO_3	Hydrogen carbonate ion	HCO_3^-
Hydrogen carbonate ion	HCO_3^-	Carbonate ion	CO_3^{2-}