Conceptual Chemistry

Chapter 10.1~10.2 (acids and bases)

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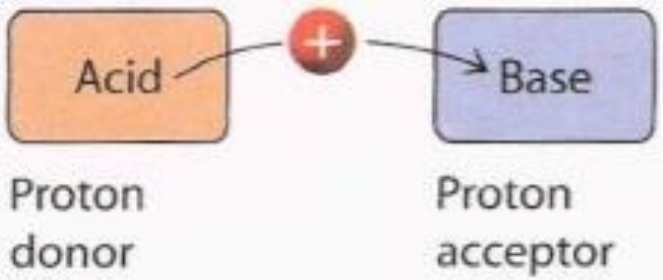
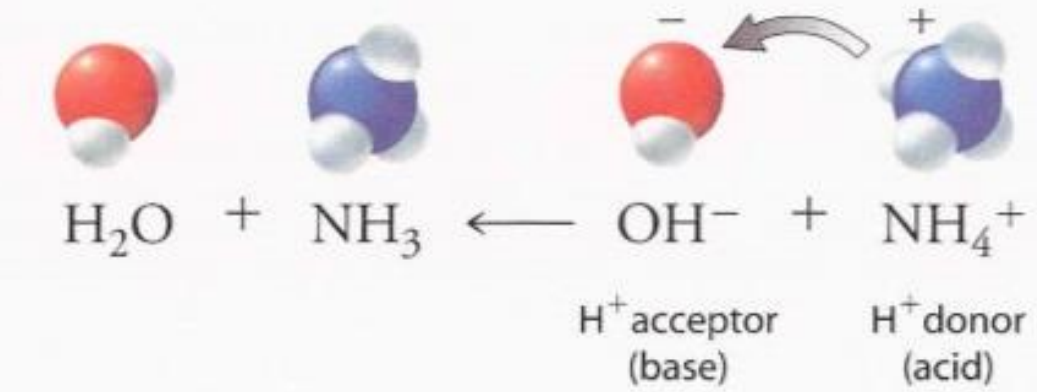
Acids	Bases
Donate Positive Charge	Accept Positive Charge

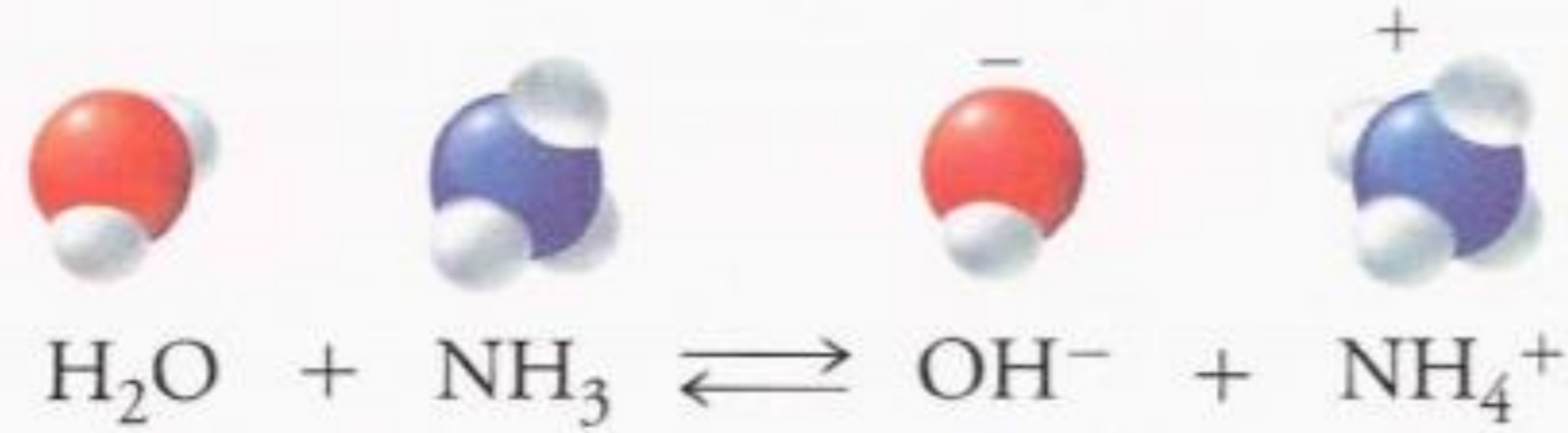


Positive Charge=Proton=H^+

Brønsted–Lowry acid–base theory

FOCUSES ON PROTONS



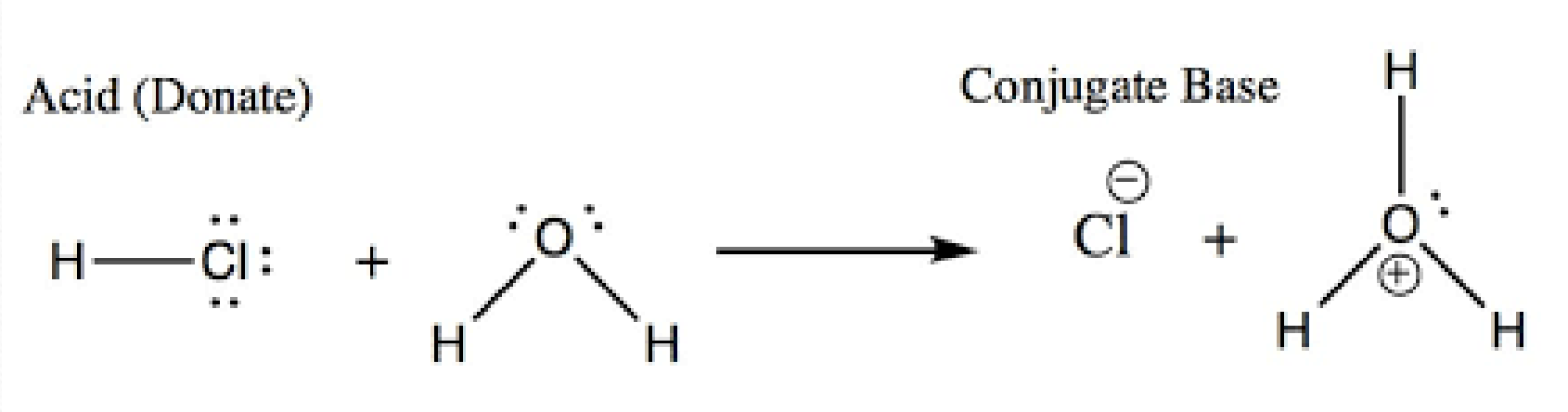


Conjugated acid-base pair

THE LEWIS DEFINITION FOCUSES ON LONE PAIRS

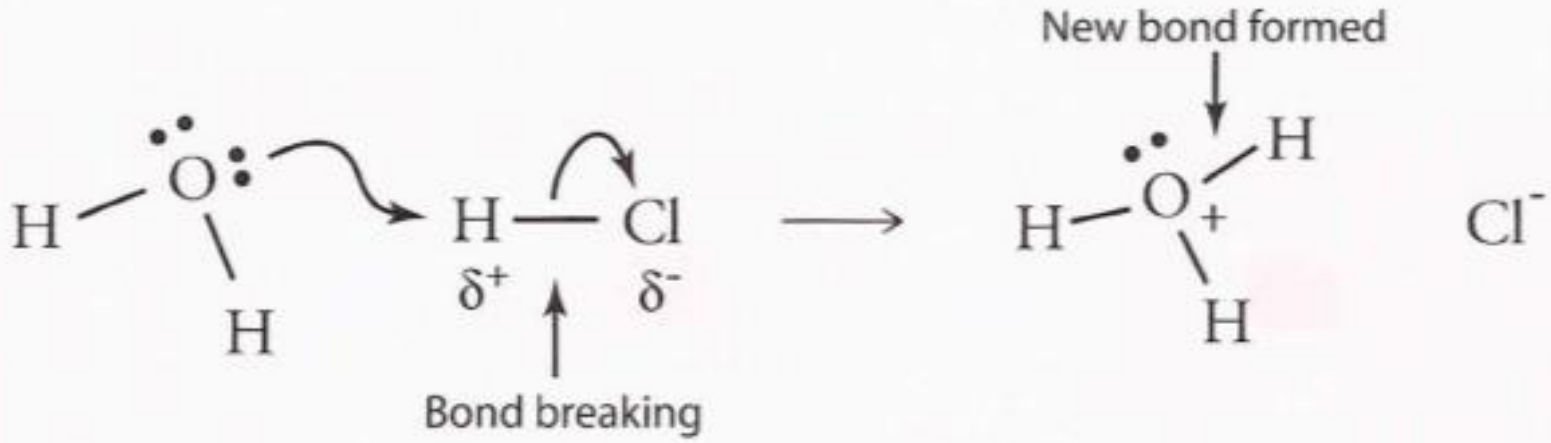
Brønsted–Lowry theory

- Acids and basesis restricted to molecules that can donate or accept protons



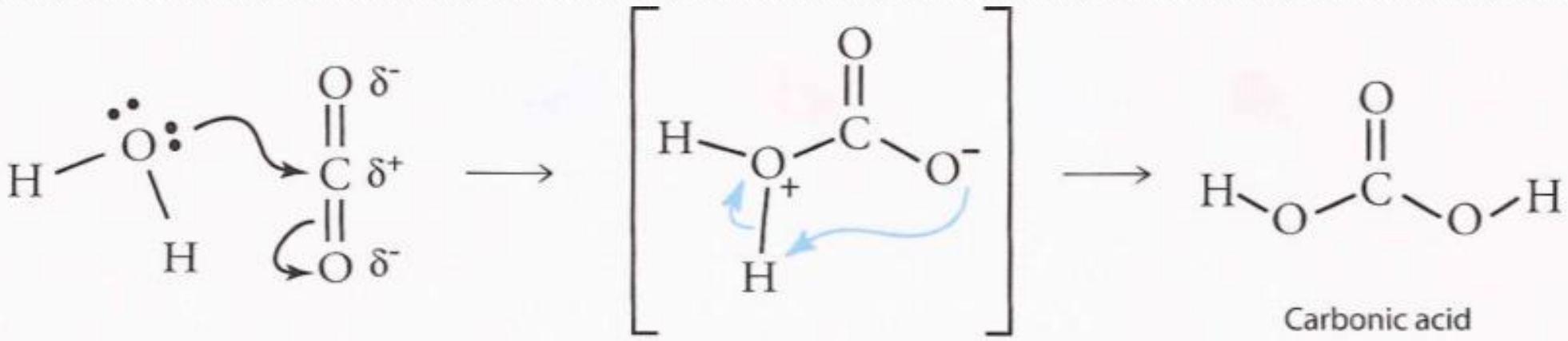
Lewis acids and bases

- A molecule with a **lone pair** of electrons can behave as a base when its lone pair accepts a positive charge.Conversely, a molecule behaves as an acid when it donates a positive charge to a **lone pair**.



Differences between two theories

- A reaction that doesn't involve the transfer of a proton is the formation of carbonic acid from water and carbon dioxide.



Explanation

- The central carbon can bear a **slight positive** charge due to the strong electronegativities of the adjacent oxygens.
- The lone pair of the water molecule attacks the slightly positive carbon of the carbon dioxide.
- As this carbon **gains the lone pair** from the water's oxygen, it **loses a bonding pair** of electrons to an adjacent oxygen.
- The result is a molecule with both a positive and negative charge.But it exists only **briefly** before transforming into the **more stable noncharged product.**

A SALT IS THE IONIC PRODUCT OF AN ACID-BASE REACTION

Salt

- Salt is a general term meaning any ionic compound formed from the reaction between an acid and a base.
- There are as many salts as there are acids and bases.
- Ex:
  - NaCN is a deadly poison.
  - KNO3 is useful as a fertilizer and in the formulation of gunpowder.
  - CaCI2 is used to deice roads, and sodium fluoride, NaF in toothpaste, prevents tooth decay...

Neutralization reaction

- The reaction between an acid and a base is called a neutralization reaction.
- the positive ion of a salt comes from the base and the negative ion comes from the acid.
- The remaining hydrogen and hydroxide ions join to form water.

The differences between Strong and Weak acids and bases

- Strong acids and bases completely dissociate (ionize) in solution.

$$HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$$

$$NaOH_{(aq)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$$

- Weak acids and bases partially dissociate (ionize) in solution.

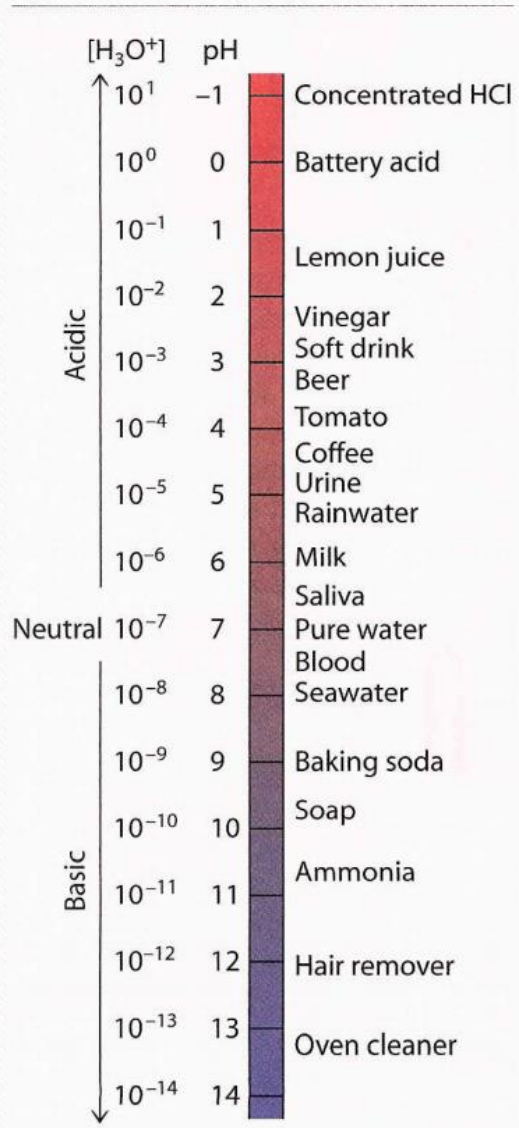
$$CH_3COOH_{(aq)} \rightleftharpoons CH_3COO^-_{(aq)} + H^+_{(aq)}$$

$$NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$$

How to distinguish strong and weak acids and bases ?

Use pH scale

- Strong acid have lower pH than weak acid.
- Strong base have higher pH than weak base.



How to determine pH scale ?

pH meter


pH
ON/OFF
CAL
14
13 Bleach
12 Soapy water
11 Ammonia solution
10 Milk of magnesia
9 Baking soda
8 Sea water
7 Distilled water
6 Urine
5 Black coffee
4 Tomato juice
3 Orange juice
2 Lemon juice
1 Gastric acid
0

If solution is acid

H+ ions outside are more than inside.

H+ ions start moving from outside to inside.

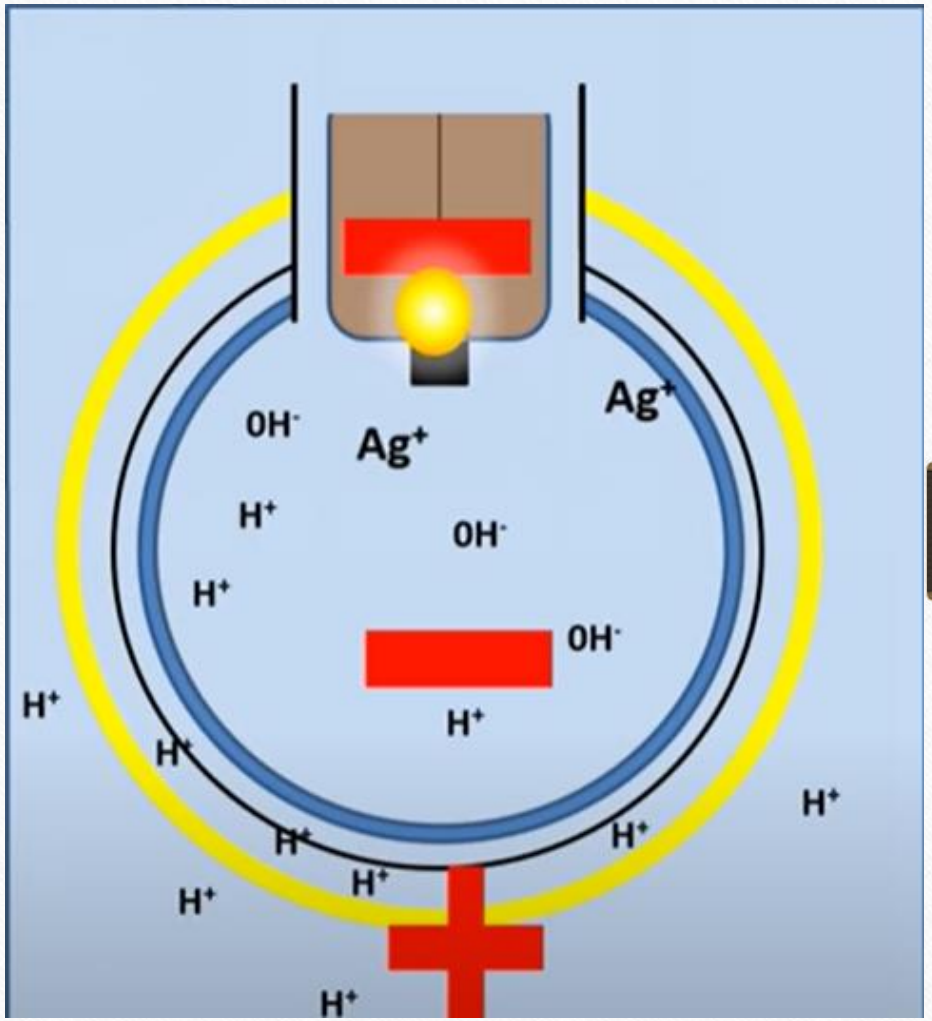
Outer membrane becomes +ve

Inner solution becomes -ve

Potential difference develops.
Current start to flow.

Change in potential sensed by reference electrode

pH calculated by Nernst equation



Nernst equation in pH meter

$$E = E_0 + 0.0591 * \log([\mathrm{H}_{\mathrm{inside}}{}^{+}] / [\mathrm{H}_{\mathrm{outside}}{}^{+}])$$

$$\Rightarrow E = E_0 + 0.0591(pH_{\mathrm{inside}} - pH_{\mathrm{outside}})$$

$$\Rightarrow E = E_0' + 0.0591 pH$$