Ch # 14

Acids, Bases and Salts

Acid Properties

- sour taste
- change the color of litmus from blue to red.
- react with
- –metals such as zinc and magnesium to produce hydrogen gas

Base Properties

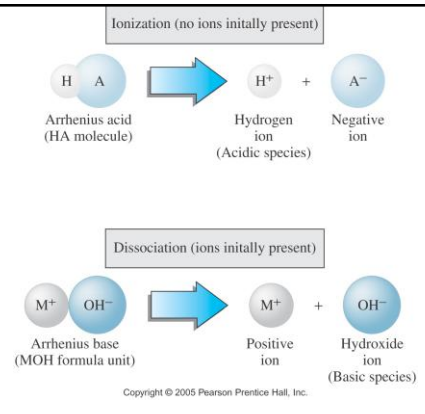
- •bitter or caustic taste
- •a slippery, soapy feeling.
- •the ability to change litmus red to blue
- •the ability to interact with acids

Arrhenius theory

- An **Arrhenius acid** "is a hydrogen-containing substance that dissociates to produce hydrogen ions."
- An **Arrhenius base** is a hydroxide-containing substance that dissociates to produce hydroxide ions in aqueous solution.
- An **Arrhenius acid** solution contains an excess of H+ ions.
- An **Arrhenius base** solution contains an excess of OH- ions.

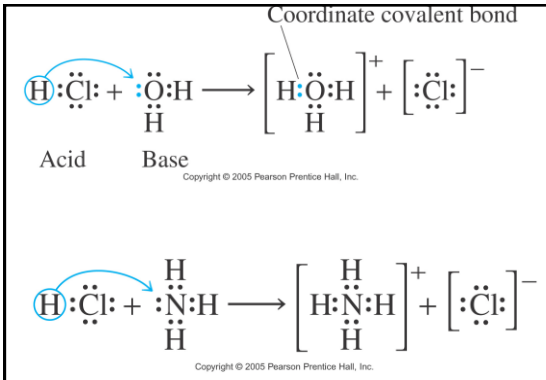
Ionization/Dissociation.

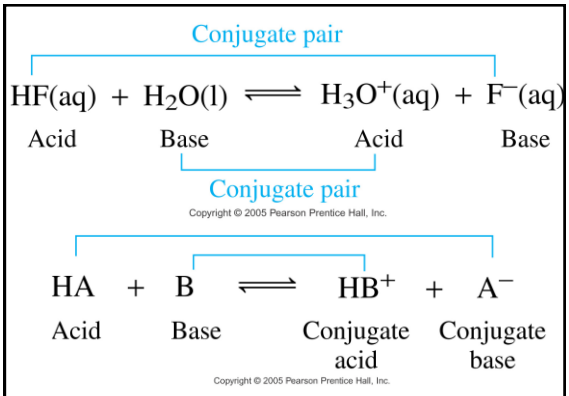
- ***Ionization***: A process in which ions are produced from a molecular compound when dissolved in a solvent.
- ***Dissociation***: A process in which already existing ions in an ionic compound separate when an ionic compound is dissolved in a solvent.



Bronsted Lowry Acid Base theory:

- A **Bronsted-Lowry acid** is a proton (H+) donor.
- A **Bronsted-Lowry base** is a proton (H+) acceptor.
- **Conjugate acid-base pairs differ by a proton.**
- When an acid donates a proton it becomes the **conjugate base**.
- When a base accepts a proton it becomes the **conjugate acid.**
- **Hydronium ion: H3O +**



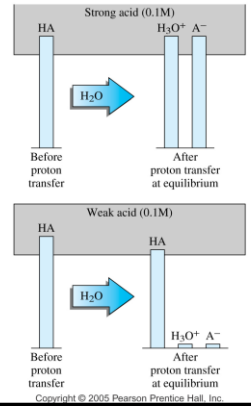


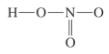
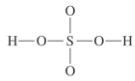
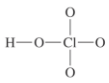
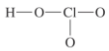
Conjugate Acids and Bases.

- ***Conjugate Acids and Bases.***
- **Determine the conjugate acid –base pairs in the following equations;**
- HBr (aq) + H2O (l) → H3O+ (aq) + Br- (aq)
- HCN (aq) + H2O (l) → H3O+ (aq) + CN- (aq)
- Write the conjugate bases for: a) HCO3 -
- _____ b) HSO4-
- _____
- Write the conjugate acids for: a) PO43-
- _____ b) HPO42-
- _____

Mono, Di, Triprotic acids:

- ***Monoprotic acid:*** Acid that can transfer only one H+ ion per molecule during an acid-base titration.
- ***Diprotic:*** Acid that can transfer two H+ ions per molecule during an acid-base titration.
- ***Triprotic***: Acid that can transfer three H+ ions per molecule during an acid-base titration.
- ***Polyprotic***: Acid that can transfer two or more H+ ions per molecule during an acid-base titration.
- ***Acidic Hydrogen atom***: A H atom in an acid molecule that can be transferred to a base during an acid base reaction.
- ***Strong acid/Weak acid***: Table 555.



Name*	Molecular Formula	Molecular Structure
Nitric acid	HNO_3	
Sulfuric acid	H_2SO_4	
Perchloric acid	$HClO_4$	
Chloric acid	$HClO_3$	
Hydrochloric acid	HCl	H—Cl
Hydrobromic acid	HBr	H—Br
Hydroiodic acid	HI	H—I

*Names in boxes for acids are discussed in Section 8.6.

Salts

- A salt is an ionic compound containing a metal ion or polyatomic ion as the ion and a nonmetal ion or polyatomic ion (except OH-) as –ve ion.

Ionic and Net ionic Equations:

- In the un-ionized equation all compounds are written using their molecular or formula expressions.
- In the total ionic equation all ions present in solution are written.
- In the net ionic equation only the ions that react are written.
- Ions that do not participate in a chemical reaction are called spectator ions.

Rules for Writing Equations

- 1.Strong electrolytes in solution are written in their ionic form.
- 2.Weak electrolytes are written in their molecular (un-ionized) form.
- 3.Nonelectrolytes are written in their molecular form.
- 4.Insoluble substances, precipitates and gases are written in their molecular forms.
- 5.The net ionic equation should include only substances that have undergone a chemical change. Spectator ions are omitted from the net ionic equation.
- 6.Equations must be balanced both in atoms and in electrical charge.

Reaction of acids:

- Acids react with metals to produce hydrogen and an ionic compound (salt).
- Reaction with Bases : The reaction of an acid with a base is called a neutralization reaction. In an aqueous solution the products are a salt and water
- Acids react with carbonates and bicarbonates to produce CO2, salt , and water.

Reactions of Bases

- Reaction with Acids The reaction of an acid with a base is called a neutralization reaction. In an aqueous solution the products are a salt and water:

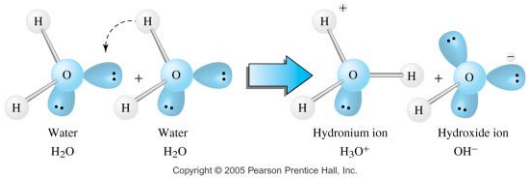
Reaction with salts:

Reaction with metals: Single replacement reaction according to activity series.

- Reaction with acids: Double displacement reaction. A new weaker acid, new insoluble salt, gaseous compound is one of the products.
- Reaction with bases: Insoluble precipitate forms, or weaker base.
- Reaction of salts with each other: Double displacement reaction. Insoluble salt is formed.

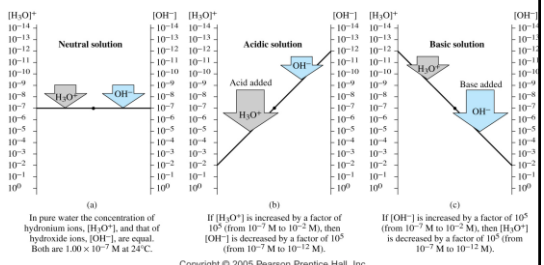
Self ionization of water:

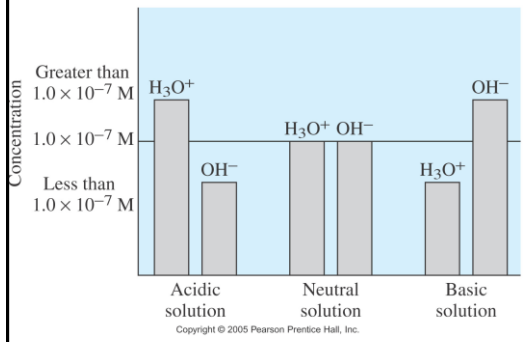
- Ion product constant for water:
- 1.00 x 10-14
- [H3O+] [OH-] = 1.00 x 10-14
- [H3O+]= 7.50 x 10-5 What is the [OH-] in this solution?



pH

- Acidic solution: [H3O+]> [OH-] pH= 0-6
- Basic solution: [H3O+]< [OH-] pH =8-14
- Neutral solution: [H3O+]= [OH-] pH =7
- pH scale: Scale that is used to specify molar hydronium ion concentration in an aqueous solution.
- pH =-log [H3O+]=- log [H+]





Problems

- Calculate pH for the following:
- [H3O+]=1 X 10-3
- [H3O+]=1 X 10-9
- [OH-]= 1X 10-4

  5) [H3O+]=3.9 X 10-5

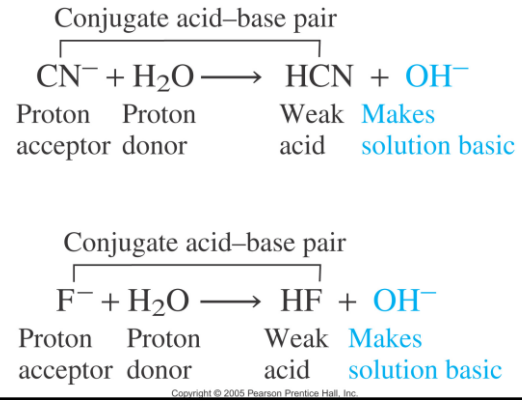
  6) [H3O+]=7.9 X 10-11
- The number of decimal places of a logarithm is equal to the number of significant figures in the original number.

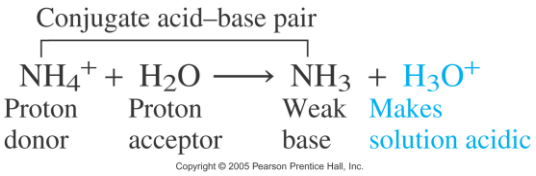
Problem

7) The pH of a solution is 5.70. What is the molar hydronium ion concentration for this solution?

Hydrolysis of a salt

- Reaction of substance with water to produce hydronium ion or hydroxide ion or both.
- Type of salt Nature
- W.B-S.A Acidic
- S.B-W.A Basic
- W.B-W.A depends on the salt
- S.B-S.A neutral





Buffers:

- A solution that resists major changes in pH when small amounts of acid or base is added to it.
  1) A substance to react with and remove added base.
- 2) A substance to react with and remove added acid.
- 3) weak acid-conjugate base.

Acid-Base titrations:

- An acid/base of known concentration is exactly reacted with a measured volume of a base/acid of unknown concentration.
- Acid + base ____ salt + water.
- Indicator: A compound that exhibits different colors depending on the pH.

8) In an acid-base titration , 32.7 mL of 0.100 M KOH is required to neutralize completely 50.0 mL of H_3PO_4 . Calculate the molarity of the H_3PO_4 solution.