Acids and Bases

Acid and Base Definitions

- An ***Arrhenius acid*** is a chemical compound that increases the concentration of hydrogen ions, H+, in aqueous solution.
- An ***Arrhenius base*** is a substance that increases the concentration of hydroxide ions, OH-, in aqueous solution.

Properties of Acids

- Aqueous solutions of acids have a sour taste.
- Acids change the color of acid-base indicators.
- Some acids react with active metals and release hydrogen gas, H_2.
  - $Ba(s) + H_2SO_4(aq) \rightarrow BaSO_4(s) + H_2(g)$
- Acids react with bases to produce salts and water.
- Acids conduct electric current.

Some Acids

- Sulfuric Acid
  - Sulfuric acid is the most commonly produced industrial chemical in the world.
- Nitric Acid
  - Used to produce fertilizers
- Phosphoric Acid
  - rust inhibitor, food additive, dental and orthopedic etchant
- Hydrochloric Acid
  - Concentrated solutions of hydrochloric acid are commonly referred to as muriatic acid.
    - Used in producing PVC, descaling, gelatin production and leather processing
- Acetic Acid
  - Pure acetic acid is a clear, colorless, and pungent-smelling liquid known as glacial acetic acid.
  - The active ingredient in vinegar

Bases

- Aqueous solutions of bases taste bitter.
- Bases change the color of acid-base indicators.
- Dilute aqueous solutions of bases feel slippery.
- Bases react with acids to produce salts and water.
- Bases conduct electric current.

pH

- pH is the measure of the –log of the H^+ Ion concentration in solution.
- Because it is the –log, the higher the concentration, the lower the number
- The pH Scale goes from 0-14
- pH of 7 is neutral
  - Less than 7 is acidic
  - Greater than 7 is basic

Strong Acids vs. Weak Acids

- A strong acid is one that ionizes completely in aqueous solution.
  - a strong acid is a strong electrolyte
  - $HClO_4$, $HClO_3$ HCl, HNO_3 HBr, HI, H_2SO_4
- A weak acid releases few hydrogen ions in aqueous solution.
  - hydronium ions, anions, and dissolved acid molecules in aqueous solution
  - HCN
  - Organic acids (—COOH), such as acetic acid

Strong acids		Weak acids	
$HI + H_2O$	$\longrightarrow H_3O^+ + I^-$	$HSO_4^- + H_2O$	$\rightleftharpoons H_3O^+ + SO_4^{2-}$
$HClO_4 + H_2O$	$\longrightarrow H_3O^+ + ClO_4^-$	$H_3PO_4 + H_2O$	$\rightleftharpoons H_3O^+ + H_2PO_4^-$
$HBr + H_2O$	$\longrightarrow H_3O^+ + Br^-$	$HF + H_2O$	$\rightleftharpoons H_3O^+ + F^-$
$HCl + H_2O$	$\longrightarrow H_3O^+ + Cl^-$	$CH_3COOH + H_2O$	$\rightleftharpoons H_3O^+ + CH_3COO^-$
$H_2SO_4 + H_2O$	$\longrightarrow H_3O^+ + HSO_4^-$	$H_2CO_3 + H_2O$	$\rightleftharpoons H_3O^+ + HCO_3^-$
$HClO_3 + H_2O$	$\longrightarrow H_3O^+ + ClO_3^-$	$H_2S + H_2O$	$\rightleftharpoons H_3O^+ + HS^-$
		$HCN + H_2O$	$\rightleftharpoons H_3O^+ + CN^-$
		$HCO_3^- + H_2O$	$\rightleftharpoons H_3O^+ + CO_3^{2-}$

Neutralization Reactions

- Acid – Base Reactions that have equal amounts of the H_3O^+ and OH^- Ions
- They produce H_2O and a Salt

List of Strong Acids and Bases

Strong Acids	Strong Bases
HCl Hydrochloric	NaOH
HBr Hydrobromic	KOH
HI Hydroiodic	RbOH
H_2SO_4 Sulfuric Acid	CsOH
HNO_3 Nitric Acid	$Ca(OH)_2$
$HClO_4$ Perchloric Acid	$Sr(OH)_2$
$HClO_3$	$Ba(OH)_2$

Self ionization of water

- Water can dissociate too!
- The normal dissociation for water is 0.0000001M H^+

pOH

- pOH is the measure of the –log of the OH^- Ion concentration in solution.
- pOH + pH = 14
- Because it is the –log, the higher the concentration, the lower the number
- The pOH Scale goes from 0-14
- pOH of 7 is neutral
  - Less than 7 is basic
  - Greater than 7 is acidic