Chapter 16 Summary

Main Concepts (Big Ideas):

Types of Acids and Bases: *Arrhenius acid-a substance that transfers a hydrogen ion to water.*
Arrhenius base-a substance that transfers a hydroxide ion to water.

Brønsted-Lowry acid-a substance that transfers a hydrogen ion to another substance. Does not have to be water.
Brønsted-Lowry base-a substance that accepts a hydrogen ion from another substance.

Lewis acid-a substance that accepts an electron pair from another substance forming a covalent bond.
Lewis base-a substance that donates an electron pair to another substance forming a covalent bond.

Conjugate acid: *The resulting substance after it has accepted a proton from a stronger acid.*

Conjugate base: *The resulting substance after a relatively strong acid has donated a proton.*

Strong acid: *a substance that completely donates its proton to another substance. Ex.: HCl, HBr, HI, H_2SO_4, HNO_3, $HClO_3$, $HClO_4$*

Weak acid: *a substance that only partially donates protons to a solution, establishing some level of equilibrium.*

pH scale: *a logarithmic approach to expressing the concentration of H^+ in an aqueous solution.*

Effect of a salt on pH: *cations and anions have the ability to react with water, removing a hydrogen or hydroxide and thus increase the concentration of the other in solution. We will cover in more detail in class.*

Some important Formulas:

$pH = -\log [H^+]$ *definition of pH.*

$K_a = \frac{[H_3O^+][A^-]}{[HA]}$ *equation of the dissociation of a weak acid.*

Percent ionization $= \frac{[H+]_{equilibrium}}{[HA]_{initial}} \times 100\%$ *Equation to determine percent of an acid that dissociates.*

$K_a \times K_b = K_w$ *the product of the equilibrium constants of the acid and base equals 1.0×10^{-14}*

Practice Problems:

#17 Designate the Brønsted -Lowry acid and the Brønsted -Lowry base on the left side of each of the following equations, and also designate the conjugate acid and conjugate base of each on the right side:

a) $NH_4^+(aq) + CN^-(aq) \leftrightarrow HCN(aq) + NH_3(aq)$

b) $(CH_3)_3N(aq) + H_2O(l) \leftrightarrow (CH_3)_3NH^+(aq) + OH^-(aq)$

c) $HCOOH(aq) + PO_4^{3-}(aq) \leftrightarrow HCOO^-(aq) + HPO_4^{2-}(aq)$

#39 The average pH of normal arterial blood is 7.4. At normal body temperature (37°C), $K_w = 2.4 \times 10^{-14}$. Calculate $[H^+]$, $[OH^-]$, and pOH for blood at this temperature.

#53 A 0.100M solution of chloroacetic acid ($ClCH_2COOH$) is 11.0 % ionized. Using this information, calculate $[ClCH_2COOH^-]$, $[H^+]$, $[ClCH_2COOH]$, and K_a for chloroacetic acid.

#75 Ephedrine, a central nervous system stimulant, is used in nasal sprays as a decongestant. This compound is a weak organic base:

$$C_{10}H_{15}ON(aq) + H_2O(l) \leftrightarrow C_{10}H_{15}ONH^+(aq) + OH^-(aq)$$

A 0.035M solution of ephedrine has a pH of 11.33.
a) What are the equilibrium concentrations of $C_{10}H_{15}ON$, $C_{10}H_{15}ONH^+$, and OH^-

b) Calculate K_b for ephedrine.

#89 Explain the following observations:

a) HNO_3 is a stronger acid than HNO_2

b) H_2S is stronger acid than H_2O

c) H_2SO_4 is a stronger acid than HSO_4^-

d) H_2SO_4 is a stronger acid than H_2SeO_4

e) CCl_3COOH is a stronger acid than CH_3COOH.

All assigned problems for the chapter: #3, 4, 6, 13, 18, 21, 25, 29, 31, 39, 43, 47, 49, 53, 57, 61, 65, 73, 75, 81, 87, 89, 99