THE CHEMISTRY OF NATURAL WATERS – ACID/BASE AND SOLUBILITY: THE CARBONATE SYSTEM

1. CARBON DIOXIDE IN WATER

A. How does the solubility of carbon dioxide gas affect the pH of a body of water?

B. How does the temperature of the liquid impact the solubility of a gas in the liquid? (Review Henry's Law for equilibria involving the solubility of a gas in a liquid)

C. As we have done previously (Acid Rain Calculation), show that the pH of a body of water in equilibrium with atmospheric carbon dioxide (concentration of 400 ppm) would have a pH of 5.6. (assume 1 atm and 25°C). (See top half of figure 10-7)

2. CARBONATE SEDIMENTS

A. How does the solubility of calcium carbonate impact the pH of a body of water? (Review how salts (ionic substances) can affect the pH of water)

B. Calculate the solubility of calcium carbonate at 25°C. (See equation on bottom half of figure 10-7 and Table 10-3).

   i.   What would the pH of the water body be under these conditions?

C. Do Problem 10-15 on page 438.

3. WATER IN EQUILIBRIUM WITH BOTH CARBON DIOXIDE AND CALCIUM CARBONATE

A. (see figure 10-7) Write out all reactions and find the net overall reaction.

B. Using the information in Table 10-3 determine the equilibrium constant for the overall reaction.

C. Calculate the solubility of calcium carbonate under these conditions. (25 °C and 1 atm with $[CO_2]$ = 400 ppm)

D. Do Problem 10-17 on page 441.

4. ALKALINITY INDICES IN NATURAL WATERS

A. Why are the concentrations of ions in real waters not the same as those in the theoretical calculations just done?

B. Define "Alkalinity" in terms of water quality.

C. Write the equation used to calculate "Total Alkalinity".

D. Do Problem 10-22 on page 447.

5. HARDNESS INDEX FOR NATURAL WATERS

A. Define "Hardness" in terms of water quality.

B. Write the equations used to calculate water hardness.

C. Do Problem 10-24 on page 449.

D. Do Problem 10-25 on page 449.