Highlights Acids/Buffers II

1. The Henderson-Hasselbalch equation (pH = pKa + log [A-]/[HA] (where A^- is what I called the 'salt' and HA is the acid) allows one to measure the pH if one knows the pKa and the amount of salt and acid. It also allows one to determine the amount of salt and acid if one knows the pH and pKa. This is a very important equation for understanding how buffers work.

2. Addition of hydrogen ions (protons = H+) to a solution is made possible by adding a strong acid, such as HCl. Subtraction of hydrogen ions is made possible by addition of a strong BASE (the only time we will use this word in class), such as NaOH. Addition of NaOH to a solution causes the OH- to interact with H+ to form water.

3. A buffer is a solution that resists changes in pH. Remember that pH is a measure of the concentration of hydrogen ions (pH = -log[H^+], so the addition or subtraction of hydrogen ions to a buffer solution has a smaller effect on the pH than the addition or subtraction of hydrogen ions to a solution of pure water.

4. Buffers act by providing protons to replace the lost protons when a strong base is added (by HA releasing H+) to replace the protons lost by forming water or by absorbing the protons added from a strong acid, like HCl. In the latter case, A- absorbs the H+ to become HA.

5. This is important - for every proton added by a strong acid, one HA is created by the buffer and one A^- is lost. Conversely, for every proton removed by NaOH, one A^- is created and one HA is lost. If this is not clear to you, please come to see me.

6. When the amount of salt equals the amount of acid in the Henderson-Hasselbalch equation, the log term equals zero. Thus, when salt = acid for a buffer, pH = pKa. When the pH is less than the pKa, there will be more acid than salt. When the pH is greater than the pKa, there will be more salt than acid.

7. Note for a buffer that when [salt] = [acid], the maximum capacity of the buffer is reached. That is, at this point, the buffer will resist changes in pH greater than at any other point.

8. Buffers are effective when the pH of the solution in which they are found is within about 1 pH unit of the pKa of that buffer. We shall assume that when the pH of a solution is more than one pH unit above the pKa, the buffer contains essentially totally the A- form (no HA). Conversely, when the pH is a solution is more than one pH unit below the pHka, the buffer contains essentially totally the HA form (no A^-).

9. When the pH of a solution is below that of the pKa, there is more HA than A^-. Conversely, when the pH of a solution is above that of the pKa, there is more A^- than HA.

10. Proteins have optimal activity at fairly specific pHs. For example, pepsin, which is an enzyme that is active in stomach (where there is a low pH, due to a lot of acid) has a maximal ability to catalyze reactions at about the pH of stomach acid. Most enzymes have their maximal ability to catalyze reactions at around the pH of body fluids - about 7.4