BIO 311C Spring 2010

Lecture 10 – Wednesday 10 Feb. 2010

The name of an ionizable functional group is slightly different, depending on its ionization state. The ionized and non-ionized forms of functional groups have very different chemical properties.



When one or more substances is dissolved in water, the result is an aqueous solution.

example: A teaspoon of sugar dissolved in a glass of water produces an aqueous solution. The cytoplasmic matrix of cells is an aqueous solution.

Although the pH of <u>pure</u> water is 7.0, some substances change the pH when they are dissolved in water.

Example: When a molecule with carboxylic acid functional group is dissolved in water, the resulting aqueous solution has an increased concentration of H_3O^+ . This can be expressed as a decrease in the pH of the solution.



An aqueous solution with a pH of (or very near to) 7 is said to be <u>neutral</u>. An aqueous solution with a pH lower than 7 is said to be <u>acidic</u>. An aqueous solution with a pH higher than 7 is said to be <u>alkaline</u> or <u>basic</u>.

Question:

If a molecule containing an ionizable functional group is placed into an aqueous solution, then what will be the ionization state of the functional group?

Answer:

It depends on the pH of the environment of the functional group.



The suffix of the names of acids changes to "ate" when they are de-protonated.8 The suffix of the names of bases changes to "onium" when they are protonated.

Not all compartments in a living cell are at the same pH value.



Effect of pH of a Cellular Compartment on the Ionization State of a Carboxyl Functional Group



acidic compartment of a cell such as a lysosome



neutral or basic compartment of a cell such as the cytoplasmic matrix

Effect of pH of a Cellular Compartment on the Ionization State of an Amine Functional Group



acidic or neutral compartment of a cell such as the cytoplasmic matrix



basic compartment of a cell such at the matrix of a mitochondrion

Effect of pH of a Cellular Compartment on the Ionization State of a phosphate Functional Group



Note: in a very acidic environment (more acidic than shown here) phosphate would not carry any net negative charge and should be called phosphoric acid. No cell compartments is that acidic. Many Biological molecules have positive and negative charges simultaneously.

Consider a molecule in the cytoplasmic matrix of a cell (~pH 7) that contains three ionizable functional groups :



Note: This molecule at pH 7 would have 3 electric charges about half of the time and 4 electric charges about half of the time. You will need to bring a pencil (and perhaps a back-up pencil) to the exam on Friday. Nothing else will be required. You will not need, and should not use, a calculator during the exam.

Exam 1 will consist of 42 multiple-choice questions and 5 additional questions.

Approximately 1/3 of the exam will emphasize chemical information provided in Chapters 2, 3 and 4 of the textbook, in the discussion periods, and in the most recent lectures. The remaining ~ 2/3 of the exam questions will primarily cover the lecture period information and corresponding textbook reading assignments.