

BIOC 462a

Additional practice problems for Exam 1 (for review in discussion sections 9/12-9/13/07)

1. **Effect of polarity of the solvent and other environmental factors on the pK_a s of weak acids**
 - A. Consider the pK_a of the α -amino group of a protein. Suppose the group has a pK_a of about 8.0 when it is exposed to H_2O on the outside of a protein, would you expect the pK_a to be higher or lower than 8 if the group were buried in the hydrophobic interior of the protein? Why?
 - B. What if that same α -amino group is in the hydrophobic interior of the protein but has the opportunity to form an ionic bond (salt link) in that hydrophobic environment with a charged Asp side chain carboxylate. How would the pK_a of the α -amino group adjacent to a $-COO^-$ group inside the protein compare with the pK_a of the α -amino group "all alone" in the hydrophobic interior? Why?
 - C. What would you expect for the pK_a of a carboxyl group in a protein under the same 3 circumstances (explain):
 - 1) exposed to H_2O
 - 2) "all alone" in the hydrophobic interior of the protein
 - 3) In the hydrophobic interior, but adjacent to an α -amino group with which it can form a salt link.

2. **Figuring out the isoelectric point (pI) of a peptide:**

- a) List all the ionizable groups on the peptide in order of increasing pK_a , with each in its LOW-pH state of ionization (where all groups in proteins would be essentially fully protonated, say pH 1), with its pK_a noted.
- b) Note the net charge on each group individually at pH 1 and add up to get the net charge at pH 1.
- c) How many equivalents of base would you have to add to get to the pI?
- d) That pH (= pI, the pH where net charge is zero) will be halfway between the pK_a s of the 2 groups surrounding that number of equivalents.

Example to discuss in discussion section:

Calculate an approximate **pI** for the peptide **Val-Cys-Arg-Phe-His-Asp-Gln**.

3. **Figuring out the net charge on a peptide at a given pH:**

- a) Start out as with a pI calculation -- list all the ionizable groups on the peptide in order of increasing pK_a , with each in its LOW-pH state of ionization (where all groups in proteins would be essentially fully protonated, say pH 1).
- b) At the given pH, which groups have pK_a s lower than that pH, and which have pK_a s higher than that pH? Groups with lower pK_a s will have lost their protons at the given pH, but groups with higher pK_a s will still be protonated at the given pH.
- c) Alter charges as necessary to reflect the states of ionization at the given pH, and add them up to get net charge on peptide.

Example to discuss in discussion section:

Find approximate net charge at pH 10 for the peptide **Val-Cys-Arg-Phe-His-Asp-Gln**.