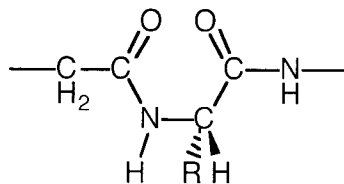


# BMB 401 (2003) Make-up Exam #2

1. Describe the predominant forces that are responsible for maintaining primary structure, secondary structure, tertiary structure, and quaternary structure in a protein (15 points).
2. If the following section of a polypeptide (left to right is N-terminus to C-terminus) is folded into  $3.6_{13}$   $\alpha$ -helix, to which amino acid is the carbonyl group of alanine noncovalently bonded (5 points)?

**A-S-V-D-E-L-G**

3. A peptide composed of only lysine residues is a random coil when the pH is less than 11; however, it forms an  $\alpha$ -helix if the pH is raised to greater than 12. Why is this the case? (5 points).
4. Discuss the effects on the oxygen saturation plots, if any, of bisphosphoglycerate binding to myoglobin and hemoglobin (5 points).
5. What type of secondary structure (specifically) would you predict that  $\beta$ -turns (hairpin turns) would aid in establishing (5 points)?
6. What are the psi and phi angles of the peptide shown below? All atoms in which stereochemistry is not specifically indicated are assumed to lie in the plane of the paper (10 points).



7. Discuss why the amino acids proline and glycine are not often found in  $\alpha$ -helices (10 points).

8. Compare and contrast the coiled-coil motifs of  $\alpha$ -keratin and collagen. What drives the coiled coil motif in keratin? Explain the significance of the G-X-P (hydroxy P) motif in collagen (15 points).
9. Explain why scurvy, a disease which correlates with weak bones, was prevalent among those who did not have access to fresh fruit (5 points).
10. Describe the process of oxygen binding to the heme of myoglobin, and the resulting structural changes that take place on the heme (10 points).
11. If the pitch of a  $3_{10}$  helix were 5 Å, what would the rise of the helix be (units purposely omitted)? (5 points).

**The following three questions (9-11) relate to a mixture of 5 different proteins. Protein A is a homohexamer, of molecular weight 120,000 daltons, and has a pI of 5.0. Protein B is a homotetramer of molecular weight 240,000 daltons, and has a pI of 6.0. Protein C is a homotrimer of molecular weight 120,000 daltons, and has a pI of 7.0. Protein D is a homodimer of 40,000 daltons, and has a pI of 9.0. Protein E is a monomer of 80,000 daltons, and a pI of 9.0.**

12. If the proteins were applied to a gel-filtration column at pH 8.0, what would be the order of elution (5 points)?
13. If the proteins were separated by SDS-polyacrylamide gel-electrophoresis, which two would you not be able to separate (5 points)?
14. If a mixture of the proteins were applied to a cation exchange column equilibrated and washed in buffer at pH 8.0, which proteins would you expect to bind to the resin (5 points)?