

BMB 401 EXAM 2

March 06, 2003

Please write your name on your exam sheet and turn it in with your Scantron sheet!

Do not forget to include your student ID on the Scan Tron Sheet. It is not necessary to include a section number.

People whose last names begin with A–C should report to room 016 Ag Sci.

1. Which of the following forces contributes **least** to the overall tertiary fold of a protein?
 - a. covalent bonds
 - b. ionic interactions
 - c. hydrogen bonds
 - d. hydrophobic interactions
 - e. van der Waals interactions
2. Which of the following forces contributes **most** to the primary structure of a protein?
 - a. covalent bonds
 - b. ionic interactions
 - c. hydrogen bonds
 - d. hydrophobic interactions
 - e. van der Waals interactions

3. What is the primary force that stabilizes repeating secondary structures as found in α -conformations, β -turns and β -helices?

- a. covalent bonds
- b. ionic interactions
- c. hydrogen bonds
- d. hydrophobic interactions
- e. van der Waals interactions

4. If the following section of a polypeptide is folded into 3.6₁₃ α -helix, to which amino acid is the carbonyl group of alanine noncovalently bonded?

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

- a. leucine
- b. aspartate
- c. serine
- d. glutamate
- e. valine

5. A peptide composed of only lysine residues is a random coil when the pH is less than 11; however, it forms an α -helix if the pH is raised to greater than 12. Why is this the case?

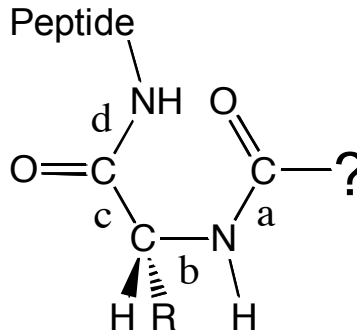
- a. The lysine residues are negatively charged at pH 12, which electrostatically stabilizes the helix
- b. At pH 12, the positive charges on the lysine residues stabilize the α -helix
- c. At pH 12, the lysine residues are neutral, which eliminates electrostatic repulsion between the R groups
- d. The high concentration of hydroxide ions in solution at pH 12 reduces the electrostatic repulsion between the R-groups
- e. At pH 12, the "Marcus Inverted Region" becomes operative, inverting the positive charges to negative charges.

6. Which of the following methods can be used to determine the quaternary structure of a protein.
- SDS-PAGE
 - Gel-filtration chromatography
 - SDS-PAGE in the presence of cross-linking agents
 - ion-exchange chromatography
 - both b and c
7. Which of the following amino acids would be expected to be the most efficiently cross-linked in a protein, if the protein were treated with a standard cross-linking agent.
- glycine
 - proline
 - lysine
 - valine
 - tyrosine
8. Calculate the length along a 3.6_{13} helix axis (axial length) of an α -helix containing 68 amino acids. Remember that the pitch of a 3.6_{13} helix is 5.4 Å.
- 68 Å
 - 1014 Å
 - 117 Å
 - 102 Å
 - 280.8 Å

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.

9. If the proteins were applied to a gel-filtration column at pH 8.0, what would be the order of elution?
- E, D, C, B, A
 - D and E, C, B, A
 - A, B, C, D and E
 - D, E, A and C, B
 - B, A and C, E, D
10. If the proteins were separated by SDS-polyacrylamide gel-electrophoresis, which two would you not be able to separate?
- A and C
 - A and D
 - D and E
 - A and E
 - All can be separated by SDS-polyacrylamide gel electrophoresis.
11. 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?
- All of the proteins
 - None of the proteins
 - A, B, and C, only
 - D and E only
 - Only C

12. In the peptide shown below, around which bond(s) is free rotation not allowed?



- a. a
- b. b
- c. c
- d. d
- e. both a and d

13. In the figure above, what atom(s) would the question mark logically represent?

- a. N-H
- b. C=O
- c. C_α
- d. H
- e. either N-H or C_α

14. If the pitch of a 3_{10} helix were 5 Å, what would the rise of the helix be (units purposely omitted)?

- a. 15
- b. 1.67
- c. 50
- d. 30
- e. 0.6

15. Which of the following amino acids would most likely be found in silk?

- a. arginine
- b. lysine
- c. proline
- d. alanine
- e. both arginine and lysine

16. In which of the following secondary structures are hydrogen bonds the least optimal?

- a. parallel β -sheets
- b. antiparallel β -sheets
- c. α -helices
- d. β -turns
- e. four helix bundles

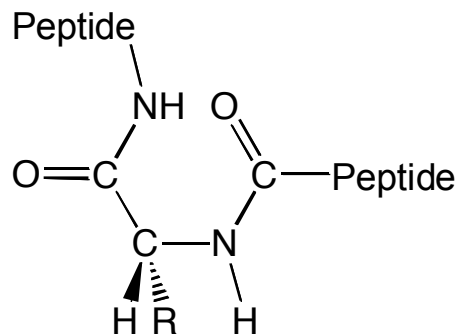
17. If a given peptide composed of L-amino acids forms a right-handed alpha helix at pH 7, what structure would it form if it were composed of D-amino acids of the exact same sequence?

- a. a right handed α -helix
- b. a left handed α -helix
- c. It would have no defined secondary structure
- d. a parallel β -sheet
- e. an antiparallel β -sheet

18. In the peptide shown below, what are the values of the angles respectively corresponding to psi and corresponding to phi?

Assume that all atoms along the peptide backbone lie in a plane.

- a. $\psi=180^\circ$, $\phi=0^\circ$
- b. $\psi=0^\circ$, $\phi=180^\circ$
- c. $\psi=0^\circ$, $\phi=0^\circ$
- d. $\psi=180^\circ$, $\phi=180^\circ$
- e. Both c and d are correct



19. In an α -helix containing 20 residues, how many hydrogen bonds deriving from the back bone amides and carbonyls are there?

- a. 20
- b. 24
- c. 40
- d. 10
- e. 16

20. When a protein is found to contain a cis peptide bond, which amino acid is usually associated with this infrequent occurrence?

- a. A
- b. W
- c. P
- d. Q
- e. G

21. What type of secondary structure are β -turns (hairpin loops) effective for establishing?
- β -helices
 - parallel β -sheets
 - antiparallel β -sheets
 - four helix bundles
 - both parallel and antiparallel β -sheets
22. What drives coiled-coil formation in α -keratins?
- the need to form disulfide bonds
 - hydrogen bonds between hydroxyproline residues
 - the need to shield hydrophobic amino acids
 - ionic interactions between lysines and glutamates on the
 - both a and d
23. Which of the following statements about collagen is false?
- it is composed of three right-handed helical strands that are wrapped in a left-handed triple helix
 - it is composed of three left-handed helical strands that are wrapped in a right-handed triple helix
 - it contains hydroxyproline residues
 - glycine residues usually occur at junctures among three strands of the triple helix
 - it contains hydroxylysine residues
24. Hemoglobin reversibly binds oxygen, protons, bisphosphoglycerate (BPG), carbon monoxide, and carbon dioxide. Which statement is incorrect about the nature of these bindings?
- oxygen binds to Fe^{2+} but not Fe^{3+} hemoglobin
 - ionic interactions are the primary forces associated with BPG binding to hemoglobin
 - when oxyhemoglobin moves to a more acidic environment, it is more apt to release its oxygen
 - carbon dioxide forms carbamate linkages to lysine side chains on all four subunits
 - carbon monoxide binds to Fe^{2+} but not Fe^{3+} hemoglobin

25. Upon a shift in concentration of bisphosphoglycerate in the blood from 8 mM to 3 mM, which of the following would be expected to take place?
- a. myoglobin would bind oxygen less well
 - b. hemoglobin would bind oxygen less well
 - c. hemoglobin would bind oxygen better
 - d. myoglobin would bind oxygen better
 - e. both hemoglobin and myoglobin would bind oxygen better.