Meisenberg: Principles of Medical Biochemistry, 3rd Edition

Chapter 2: Introduction to Protein Structure

Test Bank

MULTIPLE CHOICE

1. Which of the following is true about the tertiary structure of proteins?
a. Disulfide bonds are part of the tertiary structure.
b. Only proteins with more than one polypeptide subunit have a tertiary structure.
c. Proteins with tertiary structure do not contain α helix or β-pleated sheet.
d. Van der Waals interactions play no role in the tertiary structure.
e. Interactions between hydrophobic amino acid side chains are important for hold the tertiary structure together.

ANS: E
Hydrophobic groups associate with one another to minimize the thermodynamically unfavorable interface between lipid and water. Hydrophobic interactions and van der Waals interactions prevail in the core of globular proteins.

2. Amino acids at the isoelectric point in the titration curve have a net charge of:
a. 1.
b. +1.
c. +2.
d. 0.
e. –2.

ANS: D
This is the definition of the isoelectric point.

3. Which amino acid residues are used as attachment sites for covalently bound oligosaccharides in glycoproteins?
a. Asparagine and serine.
b. Tryptophan and glutamic acid.
c. Alanine and lysine.
d. Arginine and proline.
e. Leucine and histidine.

ANS: A
N-linked carbohydrate is bound to asparagine, and *O*-linked carbohydrate is bound to serine or threonine (or, in collagen, to hydroxylysine).

4. Which of the following is true regarding the structure shown?

$$\text{-CH2-CH2-COO}^-$$

a. Side chain of glutamine; normally found in the interior of globular proteins.
b. Side chain of glutamine; normally found on the surface of globular proteins.
c. Side chain of glutamate; normally found in the interior of globular proteins.
d. Side chain of glutamate; normally found on the surface of globular proteins.
e. Side chain of the "nonstandard" amino acid γ-carboxyglutamate, found only in some clotting factors.

ANS: D
Unlike glutamine, glutamate is negatively charged. All negatively charged amino acid side chains prefer the surface of globular proteins, where they can interact with water and dissolved ions.

5. In the tripeptide glutathione (γ-glutamyl-cysteinyl-glycine), the side chain carboxyl group of glutamate forms a peptide bond with the α-amino group of cysteine. The α-amino and α-carboxyl groups of glutamate do not participate in peptide bonds. Approximately what is the isoelectric point (pK) of glutathione?

a. 1.5.
b. 10.0.
c. 3.0.
d. 6.5.
e. 9.0.

ANS: C
There is an α-amino group (of glutamate) with a pK near 9 or 10, an α-carboxyl group (of glutamate) with a pK near 2, a carboxyl terminus (formed by glycine) with a pK near 4, and a cysteine sulfhydryl group (SH) with a pK near 8. The isoelectric point is halfway between the pK values of the two carboxyl groups.

6. Noncovalent bonds essential for the formation of the α helix and β-pleated sheet are:

a. Disulfide bonds.
b. Van der Waals interactions.
c. Salt bridges.
d. Hydrogen bonds.
e. Hydrophobic forces.

ANS: D
The hydrogen bonds are formed between the components of the peptide bonds.

7. Histones are proteins that bind to negatively charged phosphate groups of DNA. An amino acid in the histones that can mediate this binding is:

a. Valine.

b. Lysine.
c. Aspartate.
d. Cysteine.
e. Glutamic acid.

ANS: B
The lysine side chain carries a positive charge at pH values near 7.

8. The secondary structure of proteins:
a. Is maintained by hydrogen bonds.
b. Is present only in proteins consisting of two or more subunits held together by noncovalent forces.
c. Refers to any hydrogen-bonded interaction found in proteins.
d. Implies the presence of a nonprotein moiety bound to the polypeptide.
e. Is found only in fibrous proteins.

ANS: A
The hydrogen bonds are formed between the components of the peptide bonds.

9. Which of the following statements about protein structure is correct?
a. The □ helix is stabilized primarily by ionic interactions between the side chains of amino acids.
b. Cytoplasmic proteins generally contain disulfide bonds.
c. In comparison with the β-pleated sheet, the α helix is more extended.
d. The denaturation of proteins is in most cases reversible by slow cooling.
e. The tertiary structure of the protein forms before the formation of disulfide bonds.

ANS: E
Protein conformation is established by noncovalent interactions between functional groups of the polypeptide, sometimes aided by helper proteins called *chaperones.* Disulfide bonds are formed between cysteine side chains that have been brought into close proximity during the initial folding process.

10. An amino acid whose side chain is most likely to be found in the center of a tightly packed, water-soluble globular protein such as myoglobin is:
a. Serine.
b. Glutamine.
c. Aspartate.
d. Leucine.
e. Arginine.

ANS: D

Hydrophobic amino acid side chains aggregate in the core of globular proteins, to avoid contact with the surrounding water.

Better start: The leucine side chain is hydrophobic. Hydrophobic …

11. Which of the following statements is correct for protein structure?
a. The α helix is stabilized primarily by ionic interactions between the side chains of amino acids.
b. Disulfide bonds are common in cytoplasmic proteins but are not present in most proteins of the extracellular matrix.
c. The stability of the quaternary structure in proteins is a result of covalent bonds between the subunits.
d. The heat denaturation of proteins is in most cases reversible by slow cooling.
e. Glycine and proline do not usually participate in α-helical structures.

ANS: E
Glycine is too flexible, and proline is too rigid to fit comfortably in an α helix.

12. All naturally occurring amino acids:
a. Have more than one α-carbon atom.
b. Are uncharged at a pH of 7.
c. Can only have two pKs.
d. Are chiral, except glycine.
e. Occur in nature mainly or exclusively in the optically active D-form.

ANS: D
Only glycine has no asymmetrical carbon.