Chapter 2 Protein Composition and Structure

Matching Questions

Use the following to answer questions 1-10:

Choose the best answer from the list below. Not all of the answers will be used.
a) L-amino acids
b) water
c) protons
d) Zwitterions
e) secondary structure
f) tertiary structure
g) Ramachandran
h) cysteine
i) extracellular
j) histidine
k) proline
l) Sanger
m) D-amino acids

1. _____ Chiral type of amino acids found in proteins.

   Ans: a
   Section: 2.1

2. _____ Molecules with both a positive and a negative charge.

   Ans: d
   Section: 2.1

3. _____ Disulfide bonds are formed by pairs of which amino acid?

   Ans: h
   Section: 2.1

4. _____ The amino acid with a pK_a near neutral pH.

   Ans: j
   Section: 2.1

5. _____ When a peptide bond is formed, what molecule is also made?

   Ans: b
   Section: 2.2

6. _____ Name of the plot that allows one to investigate the likely orientation of certain amino acid pairs.

   Ans: g
   Section: 2.2

7. _____ The type of structure to which α helices, β sheets, and turns are referred.

   Ans: e
   Section: 2.3

8. _____ The overall three-dimensional structure of a single polypeptide is referred to as

   Ans: f
   Section: 2.4

Fill-in-the-Blank Questions

9. _____ is a fibrous protein and is the primary component of wool and hair.
   Ans: A keratin Section: 2.3

10. Every third residue in the protein collagen is _____.
    Ans: glycine Section: 2.3

11. Disulfide bonds in proteins can be reduced to free sulfhydryl groups by reagents such as _____.
    Ans: β mecaptoethanol Section: 2.6

12. A protein is considered to be _____ when it is converted into a randomly coiled structure without its normal activity.
    Ans: denatured Section: 2.6

13. _____ is the major fibrous protein present in skin, bone, tendon, cartilage, and teeth.
    Ans: Collagen Section: 2.3

14. Collagen contains _____, a modified amino acid.
    Ans: hydroxyproline Section: 2.6

15. Agents such as _____ and guanidine hydrochloride denature proteins by disrupting the noncovalent interactions.
    Ans: urea Section: 2.6

16. _____ refers to the spatial arrangement of subunits and the nature of their interactions
    Ans: Quaternary structure Section: 2.5

17. The _____ β-sheet structure occurs when the two strands are oriented in same directions (N → C).
    Ans: antiparallel Section: 2.3

Multiple-Choice Questions

18. One function of proteins is as
    A) energy carrying molecules
    B) catalysts.
    C) storage of genetic information.
    D) None of the above.
    E) All of the above.
    Ans: B Section: Introduction

19. Key properties of proteins include
    A) a wide range of functional groups.
    B) an ability to possess either rigid or flexible structures as dictated by functional requirements.
    C) the ability to interact with other proteins.
    D) a and b.
    E) All of the above.
    Ans: E Section: Introduction

20. What charged group(s) are present in glycine at a pH of 7?
    A) $-NH_3^+$ B) $-COO^-$ C) $-NH_2^+$ D) a and b E) a, b, and c
    Ans: D Section: 2.1

21. At a pH of 12, what charged group(s) are present in glycine?
    A) $-NH_3+$ B) $-COO^-$ C) $-NH_2+$ D) a and b E) a, b, and c
    Ans: B Section: 2.1

22. What do the amino acids tyr, asn and thr have in common?
    A) have aromatic rings
    B) are negatively charged at pH 7.0
    C) are positively charged at pH 7.0
    D) contain double bonds in side chains
    E) are polar
    Ans: E Section 2.1

23. Which amino acids contain a sulfur atom?
    A) serine and methionine
    B) serine and threonine
    C) methionine and threonine
    D) cysteine and methionine
    E) cysteine and threonine
    Ans: D Section: 2.1

24. Name two amino acids that are <u>positively</u> charged at a neutral pH.
    A) Lys, Arg
    B) His, Arg
    C) Cys, Met
    D) Leu, Pro
    E) Asp, Glu
    Ans: A Section: 2.1

25. In the following peptide, which amino acid is the N-terminus?
Phe-Ala-Gly-Arg
A) Ala B) Phe C) Phe and Arg D) Arg E) None of the above.
Ans: B Section: 2.2

26. What is the approximate mass of a protein containing 200 amino acids? (Assume there are no other protein modifications.)
A) 2,000 B) 11,000 C) 22,000 D) 222,000 E) None of the above.
Ans: C Section: 2.2

27. Which individual won a Nobel Prize for his landmark work in sequencing the protein insulin?
A) Pauling B) McClintock C) Gilbert D) Maxam E) Sanger
Ans: E Section: 2.2

28. Why is the peptide bond planar?
A) Bulky side chains prevent free rotation around the bond.
B) It contains partial double-bond character, preventing rotation.
C) Hydrogen bonding between the NH and C=O groups limits movement.
D) None of the above.
E) All of the above.
Ans: B Section: 2.2

29. The configuration of most peptide bonds in a protein is
A) cis. B) circular. C) parallel. D) trans. E) perpendicular.
Ans: D Section: 2.2

30. What structure(s) did Pauling and Corey predict in 1951?
A) α helix B) β sheet C) β turns D) a, b, and c E) a and b
Ans: E Section: 2.4

31. The term "quaternary" with respect to protein structure means
A) a repeating structure stabilized by intrachain hydrogen bonds.
B) the ability to form all four kinds of noncovalent bonds.
C) a multisubunit structure.
D) a linear sequence of four amino acids.
E) None of the above.
Ans: C Section: 2.5

32. Where are Ω and β turns and loops often found?
A) in a hydrophobic pocket
B) on the interior cleft
C) at the protein interface with ligand
D) on the surface of proteins
E) None of the above.
Ans: D Section: 2.3

33. What are some of the modifications that proteins acquire?
A) cleavage and trimming of the protein
B) addition of carbohydrate groups
C) phosphorylation of certain groups
D) a, b, and c
E) b and c
Ans: D Section: 2.6

34. Which of the following amino acid residues would most likely be buried in the interior of a water-soluble, globular protein?
    A) Asp
    B) Ser
    C) Phe
    D) Lys
    E) Gln
    Ans: C Section 2.5

Short-Answer Questions

35. How does a protein's amino acid sequence influence the tertiary structure?
    Ans: A protein will spontaneously fold into a three-dimensional structure determined by the amino acid sequence.
    Section: Introduction

36. What is the advantage of having 20 different amino acids available to form proteins?
    Ans: The amino acids provide a rich diversity of functional groups, which can independently contribute to protein structure and function. In addition, many can be modified, increasing the diversity of functional groups.
    Section: Introduction

37. What is the advantage of protein interaction and assembly with other proteins?
    Ans: When proteins interact or assemble, new functions and specificity become available. Protein interactions allow new binding sites at the assembly interface, as well as providing multifunctional activity and specificity, such as found in polymerases and signal transduction.
    Section: Introduction

38. What are the three aromatic amino acids?
    Ans: phenylalanine, tyrosine, and tryptophan
    Section: 2.1

39. Which amino acid side chains are capable of ionization?
    Ans: The amino acids are: Asp, Glu, His, Cys, Tyr, Lys, and Arg.
    Section: 2.1

40. How does the protein backbone add to structural stability?
    Ans: The protein backbone contains the peptide bond, which is an amide containing an NH group and a C=O (carbonyl) group. Peptide bonds are kinetically stable once formed, having very low rates of hydrolysis. Hydrogen-bond formation between the hydrogen on the nitrogen and the oxygen from other carbonyls in either alpha helicies or in beta sheets support the protein conformation.
    Section: 2.2

41. Why are all the theoretical combinations of phi and psi not possible?
    Ans: Steric hindrances of the side chains make certain combinations and angles impossible.
    Section: 2.2

42. Describe some of the features of an α helix.
    Ans: The α helix is a coil stabilized by intrachain hydrogen bonds between the carbonyl oxygen of a residue and the amide hydrogen of the fourth residue away. There are 3.6 amino acids per turn. The hydrogen bonds are between amino acid residues that have three intervening residues. Thus, these amino acid residues are found on the same side of the coil. The helix is almost always right-handed, although left-handed helices are, in theory, possible.
    Section: 2.3

43. What is the "hydrophobic effect" as it relates to protein structure?
    Ans: The three-dimensional structure of a water-soluble protein is stabilized by the tendency of hydrophobic groups to assemble in the interior of the molecule.
    Section: 2.1

44. A Keratin is referred to as a coiled-coil protein. Describe the protein structure of keratin.
    Ans: Two α helices entwined to form a very stable double helix of approximately 100 nm in length.
    Section: 2.3

45. What are prions?
    Ans: Prions are proteins that can assume (after infection or by other causes) a new protein structure, which is self-propagating. Mammalian prion diseases are fatal.
    Section: 2.6

46. What does the modification involving the attachment of acetyl groups to the amino termini of a protein do?
Ans: The acetylation of the amino termini of proteins makes these proteins more resistant to degradation.
    Section: 2.6

47. In the ribonuclease experiments performed by Anfinson, what was the significance of the presence of the reducing agent β mercaptoethanol?
    Ans: The reducing agent reduced incorrectly paired disulfide bonds, allowing them to reform with the correct pairing until the most stable conformation of the protein had been obtained.
    Section: 2.6

48. What is the advantage of having certain regions of partially correct folded regions?
    Ans: If some regions interact preferentially, lending stability to certain conformations as the protein folds, they can impact the overall structure of the protein.
    Section: 2.6