

3. An ELISA can be used for
- A) quantitative analysis.
 - B) size analysis.
 - C) absorbance measurements.
 - D) all of the above.
 - E) none of the above.
4. 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
5. The Second Law of Thermodynamics states
- A) the total entropy of a system and its surroundings always increases for a spontaneous process.
 - B) temperatures will always decrease.
 - C) the total energy of a system and its surroundings is constant.
 - D) diversity is the result of gradual evolution.
 - E) none of the above.
6. The energies for hydrogen bonds are approximately
- A) 100 kcal/mol.
 - B) 25–60 kcal/mol.
 - C) 1–3 kcal/mol.
 - D) 200 kJ/mol.
 - E) none of the above.
7. Enthalpy is defined as
- A) a spontaneous reaction.
 - B) the entropy of the system.
 - C) the heat content of a system.
 - D) all of the above.
 - E) none of the above.
8. Which of the following techniques can be used to determine the site of a disulfide bond?
- A) Edman degradation
 - B) Affinity chromatography
 - C) Diagonal electrophoresis
 - D) MALDI-TOF
 - E) SDS-PAGE

9. Which of the following is not an example of how protein sequence information can be used?
- A) It can be used to prepare antibodies.
 - B) It can be used to determine the sites of intron/exon junctions.
 - C) It can be used to compare protein sequences for similarity.
 - D) It can be used to determine evolutionary information.
 - E) It can be used to search for internal repeats.
10. Which of the following affect the sedimentation of a particle?
- A) mass
 - B) shape
 - C) the density of the solution
 - D) all of the above
 - E) a and b
11. If a particular reaction has a negative ΔG , is it likely to occur?
- A) Not unless energy is added to the system.
 - B) Yes, if it is coupled to another reaction.
 - C) Yes, it is spontaneous.
 - D) No, it will never occur.
 - E) Yes, if it takes place within a constrained area.
12. 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
13. The use of synthetic peptides includes
- A) use as antigens for making antibodies.
 - B) drugs.
 - C) "hooks" used in purification.
 - D) a and c.
 - E) all of the above.
14. Typical van der Waals energies are about
- A) 1–3 kcal/mol.
 - B) 0.5–1.0 kcal/mol.
 - C) 200 kJ/mol.
 - D) all of the above.
 - E) none of the above.

15. The K_m is

- A) equal to the product concentration at initial reaction conditions.
- B) equal to the substrate concentration when the reaction rate is half its maximal value.
- C) proportional to the standard free energy.
- D) all of the above.
- E) none of the above.

16. 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

17. Most proteins are purified using characteristics such as

- A) solubility.
- B) size.
- C) charge.
- D) specific binding affinity.
- E) all of the above.

18. List atoms commonly found in biological molecules that are often hydrogen bond acceptors.

- A) carbon
- B) oxygen
- C) nitrogen
- D) b and c
- E) all of the above

19. Reversible chemical interactions are mediated by

- A) electrostatic interactions.
- B) hydrogen bonds.
- C) van der Waals interactions.
- D) all of the above.
- E) none of the above.

20. Trypsin cleaves the peptide bond at

- A) the carboxyl side of arg and lys residues.
- B) the carboxyl side of met residues.
- C) the amino terminus.
- D) none of the above.
- E) all of the above.

21. How is specificity determined by chymotrypsin?
- A) interaction of the active site amino acids with the substrate
 - B) binding of the N-terminus amino acid at the active site
 - C) covalent binding of a his residue to the substrate
 - D) conformational change upon binding of substrate
 - E) binding of the proper amino acid into a deep pocket on the enzyme
22. Two-dimensional electrophoresis is a combination of what two techniques?
- A) isoelectric focusing and affinity chromatography
 - B) ion-exchange chromatography and SDS-PAGE
 - C) affinity chromatography and SDS-PAGE
 - D) isoelectric focusing and SDS-PAGE
 - E) isoelectric focusing and ion-exchange chromatography
23. Which of the following is not true?
- A) Enzymes force reactions to proceed in only one direction.
 - B) Enzymes alter the equilibrium of the reaction.
 - C) Enzymes alter the standard free energy of the reaction.
 - D) All of the above are true.
 - E) None of the above are true.
24. Cyanogen bromide cleaves the peptide bond at
- A) the carboxyl side of arg and lys residues.
 - B) the carboxyl side of met residues.
 - C) the amino terminus.
 - D) none of the above.
 - E) all of the above.
25. Name three amino acids that are positively charged at a neutral pH.
- A) lys, arg, and his
 - B) his, arg, and cys
 - C) cys, arg, and met
 - D) lys, arg, and pro
 - E) arg, glu, and his
26. Which amino acids contain reactive aliphatic hydroxyl groups?
- A) serine and methionine
 - B) serine and threonine
 - C) methionine and threonine
 - D) cysteine and methionine
 - E) cysteine and threonine

27. The Gibbs free energy of activation is

- A) the difference between the substrate and the transition state.
- B) the difference between the substrate and the product.
- C) the difference between the product and the transition state.
- D) all of the above.
- E) none of the above.

28. Which amino acids in chymotrypsin are found in the active site and are participants in substrate cleavage?

- A) his, ser, asp
- B) his, ser
- C) asp, lys
- D) lys, arg
- E) his, ser, arg

29. An example of how enzymes transform energy includes

- A) ion gradients.
- B) chemical bond energy.
- C) mechanical energy.
- D) b and c.
- E) a, b, and c.

30. What is the common strategy by which catalysis occurs?

- A) increasing the probability of product formation
- B) shifting the reaction equilibrium
- C) stabilization of transition state
- D) all of the above
- E) none of the above

31. 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

32. The fat-soluble vitamins include vitamin A and _____.

- A) vitamin K.
- B) vitamin D.
- C) vitamin E.
- D) a, b, and c.
- E) a and c.

33. Enzyme catalysts can be
- A) RNA.
 - B) lipids.
 - C) proteins.
 - D) a and c.
 - E) none of the above.
34. What is the approximate mass of a protein containing 200 amino acids? (Assume there are no other protein modifications.)
- A) 20,000
 - B) 11,000
 - C) 22,000
 - D) 222,000
 - E) none of the above
35. Which are types of enzyme inhibition?
- A) irreversible
 - B) reversible
 - C) temporary
 - D) a, b, and c
 - E) a and b
36. What is the advantage of adding SDS to gel electrophoresis?
- A) SDS colors the proteins for visualization.
 - B) SDS reduces disulfide bonds.
 - C) SDS allows proteins to be separated on the basis of approximate mass.
 - D) None of the above.
 - E) All of the above.
37. When enzymes are purified, the assay is often based on
- A) light absorbance.
 - B) catalytic activity.
 - C) pH.
 - D) temperature changes.
 - E) mRNA levels.
38. What is the function of ninhydrin?
- A) colorimetric agent to detect amino acids
 - B) cleavage of proteins
 - C) protein fingerprints
 - D) all of the above
 - E) none of the above

39. You are working with a dimeric protein in which each monomer is composed of two large peptide linked by disulfides. Within the dimer, one of these peptides is twice the molecular weight of the other. The smallest peptide in the monomer is 5,000 daltons. If you performed non-reducing SDS-PAGE gel electrophoresis on this dimeric protein, how many bands would appear and at what molecular weight?
- A) one band, at 30,000
 - B) one band, at 15,000
 - C) three bands, at 5,000, 10,000, 15,000
 - D) two bands, at 5,000, 10,000
 - E) none of the above
40. You seek to derive the amino acid sequence of a purified peptide. Your research technician has performed multiple tests and presents you with the following data:
Limited Carboxypeptidase A digestion: Ala
Edman degradation (1 cycle): His
Chymotrypsin digestion yields free Trp and Ala as well as 1 peptide comprised of Ala, Tyr, and His.
Elastase digestion yields a tripeptide and a dipeptide
Your technician makes five predictions about the primary sequence of the peptide. Which of the following listed below best represents the unknown peptide.
- A) NH₂-Trp-Tyr-Ala-Ala-His-COOH
 - B) NH₂-Ala-Ala-Trp-Tyr-His-COOH
 - C) NH₂-His-Ala-Tyr-Trp-Ala-COOH
 - D) NH₂-Ala-His-Tyr-Trp-His-COOH
 - E) NH₂-His-Ala-Trp-Tyr-Ala-COOH
41. Histones are proteins found in eukaryotic cell nuclei, tightly bound to DNA, which has many phosphate groups. The pI of histones is very high, about 10.8. What amino acid residues must be present in relatively large numbers in histones?
- A) Ile, Leu
 - B) Lys, His, Arg
 - C) Pro
 - D) Phe, Trp
 - E) Gly, Val, Met

42. What is the ratio of $[S]$ to K_M when the velocity of an enzyme-catalyzed reaction is 80 % of V_{max} ?
- A) 1
B) 2
 C) 4
D) 8
E) 12
43. Calculate the value of K'_{eq} if $\Delta G^{0'} = -1$ kcal/mol. Assume that the temperature is 25 C.
- A) 10 kcal/mol
 B) 5.4
C) 8
D) 5.4 kcal/mol
E) 1 M
44. For an enzyme that follows simple Michaelis-Menten kinetics, what is the value of V_{max} if V_o is equal to 1 $\mu\text{mol}/\text{min}$ at $1/10 K_M$?
- A) 1.5 $\mu\text{mol}/\text{min}$
B) 26 $\mu\text{mol}/\text{min}$
C) 110 $\mu\text{mol}/\text{min}$
 D) 11 $\mu\text{mol}/\text{min}$
E) 1 $\mu\text{mol}/\text{min}$
45. The pK values for amino acid cysteine are
 $pK_{COOH} = 1.8$
 $pK_{NH_3} = 10.8$
 $pK_{side\ chain} = 8.3$
Calculate the pI of cysteine?
- A) 2.3
B) 3.14
 C) 5.05
D) 6.05
E) 8.1
46. For the formation of a polypeptide composed of 30 amino acid residues, how many water molecules must be removed when the peptide bonds are formed?
- A) 1
B) 10
 C) 29
~~D) 30~~
E) 31

47. If you treat the following peptide with chymotrypsin, which peptide would you expect to generate?

Lys-Gly-Phe-Thr-Tyr-Pro-Asn-Trp-Ser-Tyr-Phe

- A) Lys-Gly-Phe, Thr-Tyr-Pro-Asn-Trp, Ser-Tyr, Phe
- B) Lys-Gly-Phe, Thr-Tyr-Pro-Asn-Trp-Ser-Tyr-Phe
- C) Lys-Gly-Phe, Thr-Tyr-Pro-Asn-Trp, Ser-Tyr-Phe
- D) Lys-Gly-Phe-Thr-Tyr-Pro-Asn-Trp, Ser, Tyr-Phe
- E) Lys-Gly, Phe-Thr-Tyr, Pro-Asn-Trp-Ser-Tyr, Phe

48. The recombinant DNA technology was developed in mid-70s by

- A) Sanger
- B) Scientists from Genentech Inc.
- C) Kary Mullis
- D) James Watson and Francis Crick
- E) Stanley Cohen and Herbert Boyer

49. Which of the following is correct about the HIV protease

- A) HIV protease is a heterodimer of a small and a large subunit
- B) The peptidomimetic drugs ritonavir and saquinavir contain phenyl and other bulky groups that bind in the HIV protease active site
- C) HIV protease cleaves the Pro-Pro specific bond
- D) HIV protease belongs to the cysteine protease class
- E) Sarin and DIPF are strong inhibitors of the HIV protease

50. Proteins that span biological membranes often contain a helices. Given that the insides of membranes are highly hydrophobic, predict what type of amino acids would be in such a helix.

- A) Amino acids positively charged at pH 7
- B) D-amino acids
- C) L-amino acids
- D) Polar
- E) Hydrophobic