I. **Multiple Choice (2% each, total 50%, choose the best answer)**

1. The data in the table above were collected for an enzyme-catalyzed reaction. The K_M for this enzyme is approximately

[S] mM	V_0 ($\mu M \cdot min^{-1}$)
8×10^{-6}	80
2×10^{-5}	140
8×10^{-5}	224
4×10^{-3}	277
2×10^{-2}	280
1×10^{-1}	279

A) 0.8×10^{-5} mM　　B) 2×10^{-5} mM　　C) 8×10^{-5} mM

D) $140 \ \mu M \cdot min^{-1}$　　E) $280 \ \mu M \cdot min^{-1}$
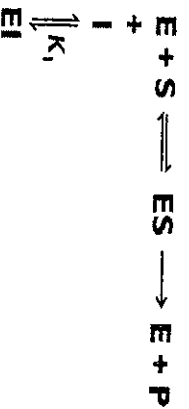
2. The enzyme reaction scheme above most closely depicts

$$E + S \rightleftharpoons ES \longrightarrow E + P$$
$$+$$
$$I$$
$$\| K_i$$
$$EI$$

A) noncompetitive inhibition　　B) mixed inhibition　　C) uncompetitive inhibition

D) competitive inhibition　　E) concerted feedback inhibition

3. The sequence of letters 'WYQN' will represent

A) Tryptophan, tyrosine, glutamic acid, asparagine　　B) Tryptophan, tyrosine, glutamine, asparagine

C) Tryptophan, glutamine, tryptophan, asparagine　　D) Glutamine, tyrosine, tryptophan, aspartic aci

4. Hydrogen bonds in α-helices are

A) more numerous than van der Waals interactions　　B) not present at Phe residues

C) analogous to the steps in a spiral staircase　　D) roughly parallel to the helix axis

5. The migration of a protein on an SDS polyacrylamide gel is best described as inversely proportional to the

A) negative charge　　B) isoelectric point　　C) log of carbohydrate content

D) log of molecular weight　　E) native volume

6. Given a unireactant enzyme reaction where a plot of 1/v versus 1/[S] gives a straight line. It was found in three additional experiments each using a different inhibitor concentration that the lines were parallel. This is an example of:

A) competitive inhibition.　　B) uncompetitive inhibition.

C) mixed inhibition.　　D) a ping-pong reaction.

7. The role of Asp 102 and His 57 during trypsin catalysis is to
   A) neutralize the charge on the other's side chain
   B) keep the specificity pocket open
   C) function as a proton shuttle
   D) clamp the substrate into the active site

8. The most definitive method for determining actin is a component of an isolated membrane preparation would be to analyze the membrane proteins by
   A) thin-layer chromatography
   B) column chromatography
   C) ultracentrifugation
   D) polyacrylamide gel electrophoresis
   E) Western blot (immunoblot)

9. In glycoproteins, the carbohydrate moiety always gets attached through which of the following amino acids?
   A) Glycine or alanine
   B) Tryptophan or phenylalanine
   C) Aspartate or glutamate
   D) Glutamine or arginine
   E) Asparagine, serine, or threonine

10. Which of the following is LEAST soluble in aqueous solution?
    A) Sucrose
    B) KCl
    C) Ethanol
    D) Palmitic acid
    E) Oxaloacetic acid

11. If the reaction A + B → C is first order with respect to A and first order with respect to B, then the rate equation for the forward reaction would be
    A) rate = k[A]
    B) rete = k[B]
    C) rate = k[A][B]
    D) rate = $k_A + k_B$
    E) rate = $k_A[A] + k_B[B]$

12. When a polymerase chain reaction (PCR) amplification was performed on human genomic DNA, multiple products of varying sizes were obtained, including one of the expected size. Which of the following modifications to the protocol is the most likely to eliminate the extra PCR products?
    A) Raising the denaturation temperature from 94°C to 96°C
    B) Raising the annealing temperature from 52°C to 56°C
    C) Raising the elongation temperature from 70°C to 74°C
    D) Increasing the elongation time from 3 minutes to 4 minutes
    E) Decreasing the number of cycles from 30 to 24

13. Matrix-assisted laser desorption ionization time of flight (MALDI-TOF) spectrometry is most useful for predicting which of the following?
    A) Molecular mass
    B) isoelectric point
    C) Bonding patterns
    D) Secondary structure
    E) Three-dimensional structure

14. The amino acid that would contribute most to protein absorption at 280 nm is
    A) Proline
    B) Tyrosine
    C) Histidine
    D) Lysine
    E) Isoleucine

15. The genetic information of viruses is contained within
    A) DNA
    B) DNA or RNA
    C) specialized proteins with defined amino acid sequence
    D) specialized carbohydrates with defined sequenc
    E) none of the above

16. What solution conditions are required for a protein to be a positively charged macroion?
    A) pH of solution is greater than the protein's pI
    B) pH of solution is less than the protein's pI
    C) pH of solution is greater than the protein's pI and ionic strength is low
    D) pH of solution is less than the protein's pI and ionic strength is low
    E) none of the above

17. At physiological pH, most amino acids are _____, meaning that they contain both a positive and negative charge.
    A) zwitterions　　　B) amphoteric　　　C) chiral　　　D) amphipathic　　　E) none of the above

18. In the equation, A = εbc, what quantity is represented by "ε"?
    A) Absorbtivity　　　　　　　　B) Molar absorbtivity
    C) Path length　　　　　　　　D) None of these

19. Which of the following pairs of amino acids could form a charge-charge interaction through their R-groups?
    A) methionine and histidine　　　B) glutamine and lysine　　　C) serine and glutamic acid
    D) aspartic acid and arginine　　　E) threonine and asparagine

20. Changes in hemoglobin's oxygen affinity are primarily the result of changes in the _____ structure of the protein.
    A) primary　　　B) secondary　　　C) tertiary　　　D) quaternary　　　E) all of the above

21. Which of the following compounds would cross a biological membrane most readily by nonmediated diffusion?
    A) water　　　B) acetone　　　C) hexane　　　D) acetic acid　　　E) methanol

22. Which of these amino acid groups would **not** make a good nucleophilic catalyst?
    A) amino　　　B) sulfhydryl　　　C) imidazole　　　D) methyl　　　E) hydroxyl

23. Which of the following segments of the integral membrane protein glycophorin most likely contains the membrane-spanning sequence?
    A) LSTTEVAMHTTTSSSVSKSY　　　　　　B) SQTNDTHKRDTYAATPRA
    C) VSEISVRTVYPPEEETGE　　　　　　　D) ITLIIFGVMAGVIGTILLI
    E) YGIRRLJKKSPSDVKPLP

24. Alcohol dehydrogenase catalyzes the conversion of methanol to _____ and is, therefore, classified as a(an) _____.
    A) acetic acid; transferase　　　　　　B) formaldehyde; oxidoreductase
    C) acetic acid; oxidoreductase　　　　　D) ethanol; lyase
    E) formaldehyde; transferase

25. Glu 35 of lysozyme is found in a nonpolar environment. Which of the following is true?

A) Its pK is lower than the usual value in this environment.

B) Its pK is higher than the usual value in this environment.

C) Its pK would not change in this environment.

D) Its pK would depend on the sample buffer.

E) None of the above is correct.

II. Essay

1. Write the reaction equation catalyzed by the following enzymes.

(a) hexokinase (2%)　　　　(b) pyruvate kinase (2%)　　　　(c) enolase (2%)

2. Explain why P_i (inorganic phosphate) is absolutely required for glycolysis to proceed. (5%)

3. Diagram the metabolic pathway from glycogen to glucose. (5%)

4. Give the reactions that produce NADH in the citric acid cycle. (5%)

5. Give the reactions that produce CO_2 in the citric acid cycle. (5%)

6. Indicate the subcellular location for the following lipid metabolisms in mammals:

(a) Fatty acid synthesis (2%)

(b) Fatty acid elongation (2%)

(c) Fatty acid desaturation (2%)

(d) Phospholipids synthesis (2%)

(e) Ketone body synthesis (2%)

7. Explain why compounds such as DNP increase metabolic rates. (4%)

8. Match (5%)

(a) Complex I _____　　　　1. Q-cytochrome c oxidoreductase

(b) Complex II _____　　　　2. Coenxyme Q

(c) Complex III _____　　　　3. Succinate-Q reductase

(d) Complex IV _____　　　　4. NADH-Q oxidoresuctase

(e) Ubiquinone _____　　　　5. Cytochrome c oxidase

9. What are the P:O ratios for electrons donated by matrix NADH and by succinate. (5%)