

This exam consists of two parts. Part I is multiple choice. Each of these 25 questions is worth two points. Answer the Part I questions on this sheet, below. Answer the Part II questions on the question pages.

Please use BLOCK CAPITAL letters like this --- A, B, C, D, E. Not lowercase!

- | | | |
|----------|-----------|-----------|
| 1. _____ | 10. _____ | 18. _____ |
| 2. _____ | 11. _____ | 19. _____ |
| 3. _____ | 12. _____ | 20. _____ |
| 4. _____ | 13. _____ | 21. _____ |
| 5. _____ | 14. _____ | 22. _____ |
| 6. _____ | 15. _____ | 23. _____ |
| 7. _____ | 16. _____ | 24. _____ |
| 8. _____ | 17. _____ | 25. _____ |
| 9. _____ | | |

GRADE:

Part I Total _____

Part II:

II-1 _____

II-2 _____

II-3 _____

II-4 _____

II-5 _____

Part II Total _____

Total, I & II _____

- 1.* Examine the amino acids drawn below:
 - A. #1 is L, #2 is L
 - B. #1 is L, #2 is D
 - C. #1 is D, #2 is L
 - D. #1 is D, #2 is D

2. What sort of protein structure is primarily stabilized by hydrogen bonding of the peptide chain?
 - A. primary structure
 - B. secondary structure
 - C. tertiary structure
 - D. quaternary structure

- 3.* What supersecondary structure is represented here?
 - A. beta sandwich
 - B. helix bundle
 - C. beta saddle
 - D. $\alpha\beta$ barrel
 - E. none of the above

4. Specific cleavage at F, Y, and W residues is catalyzed by
 - A. chymotrypsin
 - B. trypsin
 - C. cyanogen bromide
 - D. acetylcholinesterase
 - E. none of the above

5. Home pregnancy tests detect low levels of hCG by means of
 - A. Western Blotting
 - B. Equilibrium sedimentation
 - C. Amino Acid Analysis
 - D. Edman Degradation
 - E. ELISA

6. What domain of life has single celled organisms with no nucleus, found largely in "extreme" environments (strong acid, hot water, etc.)?
 - A. Eukarya
 - B. Bacteria
 - C. Archaea
 - D. Urticaria

7. Which functional group could *not* form a hydrogen bond?
 - A. alcohol
 - B. methyl
 - C. aldehyde
 - D. amide

8. Which of the following is not a precondition for Evolution?
 - A. reproduction
 - B. variation
 - C. selective pressure
 - D. plenty of food

9. Stanley Miller's experiment is flawed, because the early Earth probably never had
 - A. a reducing atmosphere
 - B. a hot ocean
 - C. lightning
 - D. amino acids

10. The size of the genome of *E. coli* is roughly
- A. 4,600 base pairs
 - B. 46,000 base pairs
 - C. 460,000 base pairs
 - D. 4,600,000 base pairs
 - E. 46,000,000 base pairs
11. It is safe to assume that homologous proteins will have very similar
- A. functions
 - B. sequences
 - C. shapes
 - E. substrates
 - F. amino acid compositions
12. Which of the following would have the *highest* (most positive) score on the BLOSUM62 Matrix as a replacement for "F"?
- A. E
 - B. D
 - C. Y
 - D. H
 - E. R
13. In the derivation of the Michaelis-Menten Equation, which assumption allows us to equate the rates of Formation and Destruction of ES?
- A. initial rate
 - B. $k_4 = 0$
 - C. $[S]$ is great
 - D. steady state
 - E. $[E] = 8$
14. Now that several genomes have been sequenced, plans are in the works to collect massive amounts of data about 3-D protein structures. What technique yields this information?
- A. ion-exchange
 - B. affinity chromatography
 - C. X-ray crystallography
 - D. rate sedimentation
 - E. Edman degradation
15. When a mixture of proteins is put through a gel filtration column, which sort of protein emerges first?
- A. positively charged
 - B. negatively charged
 - C. small diameter
 - D. large diameter
 - E. denatured
16. Reverse Transcriptase makes
- A. RNA from DNA template
 - B. RNA from RNA template
 - C. DNA from DNA template
 - D. DNA from RNA template
17. If one strand of a short stretch of DNA reads AGGTTC, the other strand will read
- A. AGGTTC
 - B. TCCAAG
 - C. GAACCT
 - D. AGCTGC
 - E. CTTGGA

18. If a solution of Hemoglobin is oxygenated to 1/2 of its capacity, what would you expect to find in the solution?
- A. The solution would contain only Hb(O₂)₂
 - B. The solution would contain roughly equal parts of Hb, Hb(O₂)₂, and Hb(O₂)₄
 - C. The solution would have mostly Hb(O₂)₂ with some Hb and Hb(O₂)₄
 - D. The solution would be 1/2 Hb(O₂)₄ and 1/2 Hb.
 - E. None of the above
19. What is the heme group?
- A. a lipid
 - B. a protein
 - C. a carbohydrate
 - D. a tetrapyrrole
 - E. a steroid
- 20.* What sugar is represented below?
- A. glucose
 - B. allose
 - C. galactose
 - D. mannose
 - E. none of these
21. Glucose is a 4-epimer of what?
- A. glucose
 - B. allose
 - C. galactose
 - D. mannose
 - E. none of these
22. If a given substrate has a low K_m with an enzyme we usually assume
- A. weak binding
 - B. strong binding
 - C. reaction is very fast
 - D. "substrate" is an inhibitor
23. If the standard free energy change (ΔG°) for a reaction is zero, then
- A. the entropy (ΔS°) of the reaction is zero
 - B. the enthalpy (ΔH°) of the reaction is zero
 - C. the equilibrium constant for the reaction is 1.0
 - D. the rxn is at equilibrium
 - E. none of the above
24. 2,3 BPG binds to Hemoglobin in its "Tense" deoxy form but not to the "Relaxed" form. Why can't it bind to "Relaxed" Hb?
- A. the oxygen gets in the way
 - B. the heme iron is too bulky
 - C. central cavity of tetramer too small
 - D. it does bind
 - E. no negative charges
25. Dr. Deis's first Biochemistry lecture was given in Wright Lab Auditorium in
- A. 1972
 - B. 1977
 - C. 1982
 - D. 1987
 - E. 1904

PART II Answer these questions here on the question pages.

1. a. The pentapeptide Ala-AsN-Gly-Glu-Arg would have what sequence when expressed in one-letter amino acid code?

(2)

- b. Draw the dipeptide Phe-Asp (FD) as it would appear at pH 7 in water.

(3)

- c. If the pKa values for Arginine are 2, 9, and 12 calculate the isoelectric point for Arginine. Show work and circle answer.

(2)

- d. Two-dimensional Gel Electrophoresis of proteins provides excellent resolving power. Describe the steps involved in 2D Electrophoresis, and be sure to name the two processes that make up the technique.

(3)

2. a. How old is most banded iron? How was it formed?

(2)

b. Is it *ever* possible to recover useful DNA from fossils? Will we be able to grow dinosaurs, as in Jurassic Park? Why or why not?

(3)

c. What two proteins are mentioned in the chapter which are homologous with Actin? Other than shape, what do the three proteins have in common?

(3)

d. Certain proteins are used as "molecular clocks" in other words perhaps you would expect to see 1 mutation every million years. How would a molecular clock be calibrated, i.e. how would scientists come up with numbers like that?

(2)

3 a. Name the three kinds of RNA found most commonly in cells. Don't just abbreviate.

(3)

b. Draw an A-T base pair. Show hydrogen bonds, and where sugars attach

(3)

(4) c. Matching:

_____ Transcription stop

_____ Translation stop

_____ discovered double helix

_____ A retrovirus

A. UGA, UAA, UAG

B. Watson Crick

C. HIV

D. an intron

E. common cold

F. AUG

G. Meselson Stahl

H. hairpin poly-U

4. a. An enzyme is found to have a V_{\max} , at a certain concentration, of 100 mM per second. The enzyme has a K_m of 6 mM. Calculate the initial rate when substrate is present at 4 mM concentration. Show work and circle answer.

(4)

- b. On axes provided, sketch the curves or lines which would be observed for an enzyme in the presence and absence of a noncompetitive inhibitor. The axes are for a double reciprocal ("Lineweaver Burk") plot.

(3)

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- c. Given that $R = 1.987 \text{ cal/}^\circ \text{ mol}$ and $T = 300^\circ \text{K}$, calculate the equilibrium constant for a reaction with $\Delta G^\circ = +7.3 \text{ kcal/mol}$.

(3)

5. a. Draw D-Mannosyl α 1-4 D-glucose. For partial credit, just draw the monosaccharides in Fischer projection.

(4)

- b. On the axes below, draw the loading curves for Hemoglobin and Myoglobin and label which is which. Also give the approximate P_{50} in torr for each curve.

(3)

- c. What is the molecular defect in HbS compared to HbA? What happens inside cells during a "sickling" attack? Why are Sickle Cell carriers relatively safe from the effects of the disease?

(3)