

Biochemistry 694:301  
First Exam, Dr. Deis  
Monday July 22, 2002

Name \_\_\_\_\_  
Last 5 digits, Soc.Sec.Num. \_\_\_\_\_  
Row Letter \_\_\_\_\_ Seat Number \_\_\_\_\_

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. At a magnification of  $10^8$ , or "2 Å per inch," an average protein would be about the size of
  - A. a house
  - B. a truck
  - C. a large pillow
  - D. an apple
  - E. a marble
2. The distinguishing feature of the Eukarya is that
  - A. they are all multicellular
  - B. they have tough cell walls around each cell
  - C. they have a well-defined nucleus within each cell
  - D. they are more primitive than the Archaea or the Bacteria
3. Which building block is found only in DNA, and helps maintain the informational integrity of DNA?
  - A. uracil
  - B. adenine
  - C. thymine
  - D. cytosine
  - E. guanine
4. Stanley Miller wrongly assumed what?
  - A. amino acids formed in early Earth atmosphere
  - B. lightning is simulated by a spark
  - C. the Earth had a reducing atmosphere
  - D. nucleotides are easily synthesized
  - E. all of the above
5. If a protein has 400 amino acid residues, what is its approximate mass?
  - A. 400 daltons
  - B. 4,400 daltons
  - C. 44,000 daltons
  - D. 188,000 daltons
  - E. none of the above
6. The "beta sheet" would be located where on a standard Ramachandran plot?
  - A. top left corner
  - B. top right corner
  - C. lower left corner
  - D. lower right corner
  - E. near the center
- 7.\* 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
8. SDS-PAGE and isoelectric focusing have what in common?
  - A. both separate native proteins
  - B. both make use of an electrical field
  - C. both separate proteins by mass only
  - D. both require a pH gradient
  - E. all of the above
9. The most *accurate* value of a protein's molecular weight would come from
  - A. SDS PAGE
  - B. Amino Acid Analysis
  - C. MALDI-TOF
  - D. ELISA
  - E. Gel Filtration

10. Reverse Transcriptase makes  
 A. RNA from DNA template C. DNA from DNA template  
 B. RNA from RNA template D. DNA from RNA template
11. If one strand of a short stretch of DNA reads AGGTTC, the other strand will read  
 A. AGGTTC D. AGCTGC  
 B. TCCAAG E. CTTGGA  
 C. GAACCT
12. Which was described in a handout as "stupid"?  
 A. Albino monkey-bear D. Chambered Nautilus  
 B. Octopus E. Fish  
 C. Number Five
13. Human ribonuclease and Bovine ribonuclease are  
 A. paralogs D. infralogs  
 B. orthologs E. yulelogs
14. It is safe to assume that homologous proteins will have very similar  
 A. functions E. substrates  
 B. sequences F. amino acid compositions  
 C. shapes
15. Which of the following would have the *lowest* (most negative) score on the BLOSUM62 Matrix as a replacement for "F"?  
 A. E D. L  
 B. W E. M  
 C. Y
16. The addition of a certain inhibitor to an enzyme reaction makes it appear that less enzyme is present. The inhibition must be  
 A. competitive E. incompetent  
 B. noncompetitive F. covalent  
 C. uncompetitive
17. If the standard free energy change ( $G^\circ$ ) for a reaction is zero, then  
 A. the entropy ( $S^\circ$ ) of the reaction is zero D. the rxn is at equilibrium  
 B. the enthalpy ( $H^\circ$ ) of the reaction is zero E. none of the above  
 C. the equilibrium constant for the reaction is 1.0
18. In the derivation of the Michaelis-Menten Equation, which assumption allows us to ignore the back reaction,  $E + P$ ?  
 A. initial rate D. steady state  
 B.  $k_4 = 0$  E.  $[E] = 8$   
 C.  $[S]$  is great

19. 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  $\text{Hb}(\text{O}_2)_2$
  - B. The solution would contain roughly equal parts of Hb,  $\text{Hb}(\text{O}_2)_2$ , and  $\text{Hb}(\text{O}_2)_4$
  - C. The solution would have mostly  $\text{Hb}(\text{O}_2)_2$  with some Hb and  $\text{Hb}(\text{O}_2)_4$
  - D. The solution would be 1/2  $\text{Hb}(\text{O}_2)_4$  and 1/2 Hb.
  - E. None of the above
20. 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
- 21.\* The sugar shown here is
- A. ribose
  - B. xylose
  - C. mannose
  - D. galactose
  - E. allose
22. -D-Mannose and -D-Glucose are
- A. 2-epimers
  - B. 3-epimers
  - C. 4-epimers
  - D. enantiomers
  - E. anomers
23. Acid hydrolysis will break all ester, amide, and acetal chemical linkages. Which statement is not correct about acid hydrolysis of various lipids?
- A. a cerebroside releases 2 fatty acids and one sugar per mole
  - B. phosphatidylcholine releases 2 fatty acids and one glycerol per mole
  - C. sphingomyelin and phosphatidylcholine both release choline and Pi
  - D. cerebroside and sphingomyelin each releases one mole of sphingosine
24. Which of the following statements about biological membranes is *not* true?
- A. they contain carbohydrates covalently bound to proteins and lipids
  - B. they are very large sheetlike structures with closed boundaries
  - C. they are symmetrical due to the symmetry of the lipid bilayers
  - D. they contain specific proteins that mediate their distinctive functions
25. After this test I will
- A. laugh
  - B. cry
  - C. sleep
  - D. drink
  - E. work
  - F. can't tell from data provided

PART II Answer these questions here on the question pages.

1. a. Explain the effect that van der Waals forces have in folding of globular proteins. What sort of structures can be affected by van der Waals forces? How would proteins fold differently in a world without van der Waals forces?

(3)

- b. What three characteristics are required for evolution to occur?

(3)

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- c. How old is most banded iron? How was it formed?

(2)

- d. 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?

(2)

2. a. The pentapeptide Cys-His-Ala-AsN-Glu-Tyr would have what sequence when expressed in one-letter amino acid code?

(2)

\_\_\_\_\_

- b. Draw the dipeptide Arg-Pro (RP) as it would appear at pH 7 in water.

(3)

c. You are examining the first helix from the beta chain of someone with sickle cell trait. Please enter the sequence given below on the Schiffer and Edmundson wheel provided, and describe your interpretation of what you see on the wheel. Can you explain how this leads to the polymerization of deoxyhemoglobin in sickle cell disease? Also there are several amino acids before P – why would the helix start with P instead of four amino acids earlier?

PVEKSAVTASWGKVNTDY

(5)

3. a. Draw the Edman Reagent and show how it reacts with a peptide chain (in basic solution – first step only).

(3)

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

(3)

- (4) c. Matching:

\_\_\_\_\_ Transcription stop

\_\_\_\_\_ Translation stop

\_\_\_\_\_ showed Replication is semi-conservative

\_\_\_\_\_ A retrovirus

A. common cold

B. Watson Crick

C. HIV

D. hairpin poly-U

E. UGA, UAA, UAG

F. AUG

G. Meselson Stahl

H. an intron

4. a. An enzyme is found to have a  $V_{\max}$ , at a certain concentration, of 100 mM per second. The enzyme has a  $K_m$  with its substrate of 2 mM. Calculate the initial rate when substrate is present at 8 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 competitive 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  $T = 300^\circ$ , calculate the equilibrium constant for a reaction with  $G^\circ = -3.3 \text{ kcal/mol}$ .

(3)

5. a. Draw Lactose in the Haworth projection. Lactose is D-galactosyl b 1-4 D-glucose. For partial credit, just draw the monosaccharides in Fischer projection.

(4)

- b. The lipid drawn below has a superficial resemblance to phosphatidyl ethanolamine. What are the differences, and where is this lipid found in nature?

\*

(2)

- c. Draw the steroid nucleus (as found in cholesterol).

(2)

- d. Show the structure of the Fluid Mosaic Model of membrane structure. Your membrane should include some proteins and cholesterol. Label the parts.

(2)