

Biochemistry 694:301
First Exam Dr. Deis
Mon. Oct. 1, 2001

Name _____
I.D. 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. On the scale of the CPK models used in class, i.e. magnification of 10^8 , an average amino acid would be about the size of a
 - A. a house
 - B. a truck
 - C. a large pillow
 - D. an apple
 - E. a marble

2. DNA base pairs are connected by hydrogen bonds. What force causes them to "stack" against each other in the double helix?
 - A. more hydrogen bonds
 - B. van der Waals forces
 - C. hydrophobic attraction
 - D. ionic forces
 - E. none of the above

3. Which amino acid has an R group which can NOT form hydrogen bonds?
 - A. S
 - B. L
 - C. T
 - D. Y
 - E. E

4. The planar structure of a peptide bond includes how many atoms?
 - A. 2
 - B. 4
 - C. 6
 - D. 10
 - E. 24

5. Secondary structures are generally stabilized by
 - A. salt bridges
 - B. magnetism
 - C. van der Waals forces
 - D. hydrophobic forces
 - E. peptide H bonds

- 6.* 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

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

8. Some proteins can fold up rapidly and spontaneously. Proteins which need chaperones (heat shock proteins, Gro-EL) are likely to be
 - A. alpha helical
 - B. large, hydrophobic
 - C. small, globular
 - D. beta sheets
 - E. from yeast or fungus

9. 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

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 $\text{Hb}(\text{O}_2)_2$
 - 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
19. What is the heme group?
- A. a lipid
 - B. a protein
 - C. a carbohydrate
 - D. a tetrapyrrole
 - E. a steroid
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. Consider the simple chemical reaction, $A \rightarrow B$. Suppose that at the start of the reaction, A is 11 M and B is 1 M. At the end of the reaction, A is 6 M and B is 6 M. To calculate the Gibbs Free Energy at the start of the reaction, we would have to solve:
- A. $G = 1 + RT\ln(1)$
 - B. $G = 0 + RT\ln(11)$
 - C. $G = 11 + RT\ln(12)$
 - D. $G = 0 + RT\ln(1/11)$
 - E. none of the above
22. Is it possible for a reaction with a positive Gibbs Free Energy change to go forward? Note, this is **not** the Standard Free Energy change.
- A. yes, they always go forward
 - B. no, they can never go forward
 - C. sometimes forward
 - D. none of above
23. One difference between Competitive and Non-competitive Inhibitors is that Competitive Inhibitors
- A. bind at a distance from the active site
 - B. trap S in the active site
 - C. prevent S from binding at the active site
 - D. always change the V_{\max}
 - E. none of the above
24. If a given substrate has a high K_m with an enzyme we usually assume
- A. weak binding
 - B. strong binding
 - C. reaction is very fast
 - D. "substrate" is an inhibitor
25. Which was described in a handout as "stupid"? (not for credit)
- A. Lemur
 - B. Octopus
 - C. Number Five
 - D. Chambered Nautilus
 - E. Fish
 - F. I have no clue

PART II Answer these questions here on the question pages.

1. a. The pentapeptide Ala-Asn-Lys-Leu-Glu would have what sequence when expressed in one-letter amino acid code?

(2)

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

(3)

- c. If the pKa values for Aspartate are 2, 4, and 10, calculate the isoelectric point (pI) for Aspartate. Show work and circle answer.

(2)

- d. To 1 mole of Aspartate in its isoelectric form is added 0.2 moles of NaOH. What is the pH of the resulting solution? Show work, circle answer.

(3)

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

(3)

- b. What do the letters "SDS PAGE" stand for? Describe briefly how the method works to separate proteins.

(4)

- c. Matching – Amino Acid Analysis

(3)

- | | |
|--------------------------------|---------------------|
| _____ column to separate AA | A. Glutamine |
| _____ destroyed by this method | B. Tyrosine |
| _____ AA visualized by | C. cation exchanger |
| | D. anion exchanger |
| | E. Sanger's reagent |
| | F. Ninhydrin |

3. a. Draw an AT base pair. Show complete structures for "bases" - and show where sugars attach but no sugar structures are necessary ("stick" is OK).

(3)

- b. Using the "stick and P" system, show how DNA Pol I would add a "C" to the sequence ATG. You don't need to represent the template strand. Do show the "C" nucleotide as it appears before and after the reaction.

(3)

- c. Matching:

- (4) _____ Watson and Crick
_____ Fred Sanger
_____ Oswald Avery
substance
_____ Meselson and Stahl
- A. Discovered double helix
B. Discovered alpha helix
C. Replication is semiconservative
D. Discovered bacterial transformation
E. Showed DNA was transforming
F. Sequenced first protein, Insulin
G. T2 phage has DNA genes

4. a. 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.

(4)

- b. Draw 2,3 BPG and briefly explain how it helps Hemoglobin function as efficiently as it does in human erythrocytes. Be concise but complete.

(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)

5. 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 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)

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

(3)