Chemistry 452
Biochemistry Exam 3, March 13, 2000

This exam contains 10 questions. Each question is worth 10 points.

**Question 1.** Fill in the missing boxed items. Provide both structure and name for urea cycle intermediates.

(a) \( \text{H}_2\text{N-C-OPO}_3^{2+} \) synthetase I

substrates

(b) \( \text{H}_2\text{N-C-OPO}_3^{2+} \) ornithine transcarbamoylase

citrulline

(c) +Asp AMP +

+ATP P-P_i

argininosuccinate synthetase
Question 1. continued

(d) argininosuccinase
argininosuccinate $\rightarrow$ Arg +

(e) Arginine + H$_2$O $\rightarrow$ ornithine +
enzyme
Question 2. Write a detailed mechanism for tyrosine aminotransferase (transaminase), describing the role of the pyridoximine phosphate cofactor in the interconversion of tyrosine and its corresponding α-keto acid. You may assume that the mechanism is similar to that of aspartate aminotransferase.
Question 3. The figure below is from an article by Foote and Schachman (1985), "Homotropic effects in aspartate transcarbamoylase," that was assigned reading from your course pack. Explain why the observed velocity first increases and then decreases as the concentration of the inhibitor PALA is increased. Interpret these observations in terms of the Monod-Wyman-Changeux symmetry model for allosteric regulation.
**Question 4.** Listed below are statements that describe the symmetry model for allosteric transitions formulated by Monod, Wyman, and Changeux in your assigned reading in the course pack. For each statement, provide specific and detailed information about aspartate transcarbamoylase that is consistent with these statements.

(1) Allosteric proteins are oligomers the protomers of which are associated in such a way that they all occupy equivalent positions. This implies that the molecule possesses at least one axis of symmetry.

(2) To each ligand able to form a stereospecific complex with the protein there corresponds one and only one site on each protomer. In other words, the symmetry of each set of stereospecific receptors is the same as the symmetry of the molecule.

(3) The conformation of each protomer is contrained by the association with the other protomers.
Question 4 (continued)

(4) Two (at least two) states are reversibly accessible to allosteric oligomers. These states differ by the distribution and/or energy of inter-protomer bonds, and therefore also by the conformational constraints imposed upon the protomers.

(5) As a result, the affinity of one (or several) of the stereospecific sites towards the corresponding ligand is altered when a transition occurs from one to the other state.

(6) When the protein goes from one state to another state, its molecular symmetry (including the symmetry of the conformational constraints imposed upon each protomer) is conserved.
Question 5. Describe the steps involved in the formation of an “open complex” during transcription initiation in E. coli. Include the important DNA sequences involved and the role of specific proteins in your answer.
Question 6.

a) Give a detailed explanation for the following terms regarding the genetic code:
- triplet
- nonoverlapping
- unpunctuated
- redundancy

b) For two of the characteristics listed above, describe an experimental result used to prove or support that characteristic.
**Question 7.** Discuss the difference between cis and trans-acting elements. Be detailed in your answer, using the *lac* operon as an example.
Question 8. Briefly discuss the role of the following proteins in translation and transcription.

a) $\sigma$ factor

b) repressor

c) Elongation factor-Ts (EF-TS)

d) Release Factor 3 (RF-3)

e) 16s rRNA
Question 9. The following polypeptide template was used in a cell-free translation reaction. Give the product(s) of this reaction. Without prior knowledge of the genetic code, what information does/doesn't this experiment give you about the code?

5'---UCAUCAUCAUCA---3'
Question 10. DNA damage is repaired by one of the three following mechanisms. Comment on each approach and give a specific example for two of them.
   
a) reversal of DNA damage
   
b) excision of damaged DNA
   
c) recombination