

**Indian Institute of Science Education and Research Kolkata**

**LS2101 Biochemistry**

**Final Examination Fall 2018**

**Signature of invigilator**

Name \_\_\_\_\_ ID \_\_\_\_\_

Part 1- /25

Part 2- /25

Total: /50

*Supratim Chatterjee*  
*Ram*

**Part-1 – 25 marks**

1. **5 pts.** Write down the name of the intermediates of the glycolytic cycle up to pyruvate. Indicate which intermediates will result in consumption and production of ATP.

2. 3 pts. Answer the questions below on the proposed mechanism of chymotrypsin.

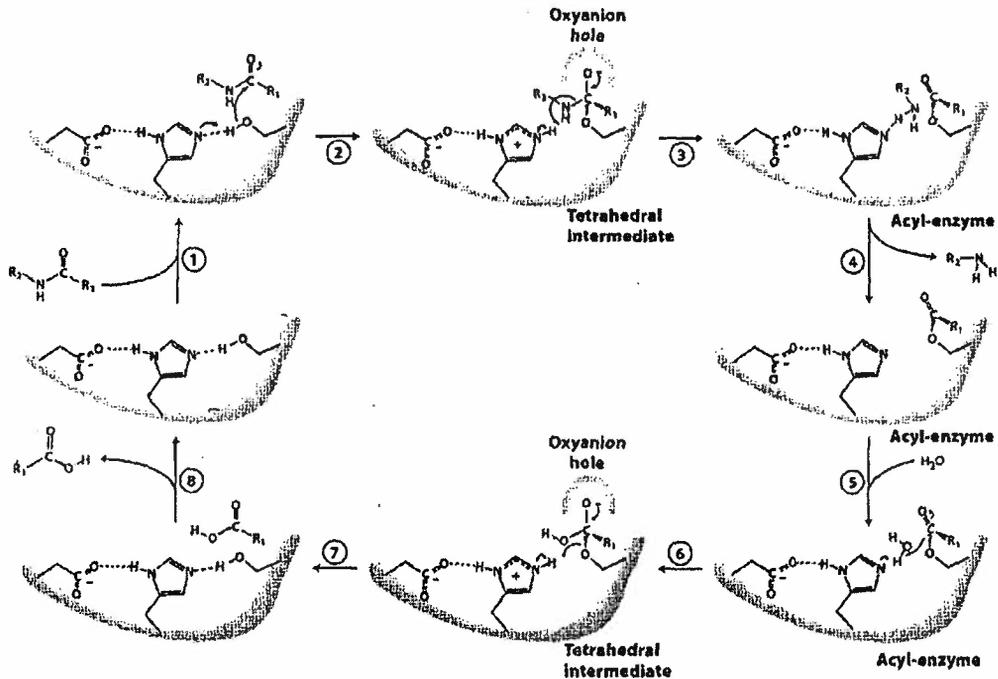


Figure 8.25  
 Biochemistry: A Short Course, Third Edition  
 © 2015 Macmillan Education

Which residue of the triad acts as a general acid to stabilize the leaving groups

What is the function of the aspartate residue in step 6

Which step is an example of a nucleophilic reaction

3. (5 pts) Write the letter or letters that match the statement to the enzyme. Enzymes may have more than one answer or no answers, but each statement is used only once.

\_\_\_\_\_ malate dehydrogenase

\_\_\_\_\_ aconitase

\_\_\_\_\_  $\alpha$ -ketoglutarate dehydrogenase

\_\_\_\_\_ fumarase

\_\_\_\_\_ succinate dehydrogenase

\_\_\_\_\_ citrate synthase

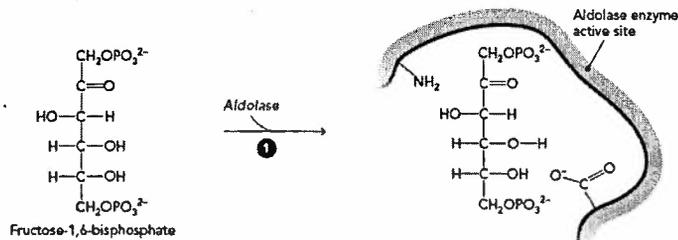
\_\_\_\_\_ succinyl-CoA-synthase

\_\_\_\_\_ isocitrate dehydrogenase

- A. Hydrolyzes a thioester bond to make a reaction irreversible
- B. Hydrolyzes a thioester bond to produce ATP
- C. Catalyzes a decarboxylation reaction using TPP
- D. Catalyzes a hydration reaction (addition of water)
- E. Produces NADH in a reversible step
- F. Catalyzes the formation of a 6-carbon tricarboxylic acid
- G. Isomerization reaction
- H. Also known as complex II
- I. Spontaneous decarboxylation that requires NAD<sup>+</sup> but no other cofactor
- J. Analogous to pyruvate dehydrogenase complex

Answer **either 4 or 5**

4. (7 pts) Draw the mechanism for the aldolase reaction, which converts F(I,6)BP to GAP + DHAP, What is the function of the Schiff's base in this mechanism? (Bonus 2 pts)





5a. (1.5 pts) Write down the reaction catalyzed by pyruvate carboxylase and name the cofactor used. Include the structure of starting material and products. You do not need to draw the mechanism

5b. (1.5 pts) Draw the starting material and products of the CAC redox reaction that is a TPP mediated oxidative decarboxylation

5c (1.5 pts) Draw the starting material and products of the CAC redox reaction that utilizes NADH but is not a oxidative decarboxylation

5d (1.5 pt) Citrate synthase condenses oxaloacetate (OAA) and acetyl-CoA. Draw the structure of OAA and indicate the electrophilic carbon

5e (1 pt). Identify the oxidant and reductant in the reaction- Pyruvate + NADH=>lactate + NAD<sup>+</sup>

6a (2pt) Describe the two ways in which an enzyme catalyzed reaction may be made favorable even when  $\Delta G^{\circ}$  favors the reactants over the products.

6b (1 pt) The ETC produces energy to drive ATP synthesis. How is energy stored during the ETC, and how is it used to drive ATP synthesis (one sentence only)

6c (1 pt) How is the ETC uncoupled from ATP synthesis (one sentence)

6d (1 pt) What is the name of the oxidized form and reduced form of Coenzyme Q in the electron transport chain?

LS2101 Part-2 – 25 marks

1. Choose the correct answer from the given options and write a brief explanation for each of the following questions. [12]

A. In a 25-residue peptide, two consecutive proline residues located at the middle of the peptide are in cis conformation. To change the conformation of the proline residues from energetically unfavorable cis- conformation to energetically favorable trans- conformation, which dihedral angle you will need to change

- I.  $\psi$
- II.  $\theta$
- III.  $\omega$
- IV.  $\chi$

B. You are given a mixture of two proteins, Protein-A and Protein-B dissolved in 0.1 M Tris buffer pH 8. The pI for Protein-A is 7.2 and pI for Protein-B is 8.0. What would be net charge of the protein in the given buffer:

- I. Protein-A is positively charge and Protein-B is negatively charge
- II. Protein-A is negatively charge and Protein-B is neutral
- III. Protein-A is positively charge and Protein-B is neutral
- IV. Protein-A neutral and Protein-B is positively charge

C. Which of the non-covalent interactions are found in a DNA double helix:

- I. H-bond between the complementary bases
- II. Aromatic stacking interaction
- III. Both I and II
- IV. None of the above

D. A protein (P) binds to two ligands (L) with a Hill's-coefficient of 0.4. Indicate if P and L interaction show

- I. Positive co-operativity
- II. The two ligands bind independently
- III. Negative co-operativity
- IV. None of the above

E. Which of the following amino acid does not have a chiral center:

- I. Alanine
- II. Tyrosine
- III. Glycine
- IV. Serine

F. Which of the following solvent will stabilize an isolated alpha-helical peptide:

- I. Water (polar solvent)
- II. DMSO (non-polar solvent)
- III. Saline (Contain 150 mM NaCl)

2. You are given a mixture of two proteins, PA and PB of 50 kDa, and 200 kDa respectively. Explain what method you will use and why, to separate these two proteins PA and PB in their native states. [2]

3. The melting point ( $T_m$ ) of a double stranded DNA will depend on the G:C content. Explain. [3]

4. Explain why vitamin C deficiency causes scurvy. [3]

5. Explain how does the binding of oxygen to Myoglobin differ from binding of oxygen to Hemoglobin. [3]

6. Why lowering the pH cause Hemoglobin to release the oxygen? [2]