BCH 4053 **FINAL EXAM** **NAME**_____
April 23, 2001

Answer question 1 or 2 (16 points)

Page	Points
1	____
2	____
3	____
4	____
5	____
Total	_____

1. Asp-52 and Glu-35 have been shown to be essential residues for catalysis by the enzyme lysozyme. Asp-52 has a pK of 3.5, and Glu-35, being in a hydrophobic environment, has a pK of 6.3.

   (a) What **fraction** of each of these residues is **protonated** at pH 5.0**?**
   (b) Describe the substrate for lysozyme, and the reaction lysozyme catalyzes (structure or word description).

2. A heptapeptide gave 2,4 dinitrophenylleucine on N-terminal analysis, and free Met as the first product with carboxypeptidase. Trypsin treatment gave a tripeptide (composition: Lys, Leu, Tyr) and a tetrapeptide (composition: Trp, Met, Ala, Glu). Chymotrypsin teatment of the tetrapeptide gave two dipeptides, one migrating to the positive electrode and one migrating to the negative electrode upon electrophoresis at pH 4.5 The dipeptide migrating to the positive electrode showed U.V. absorption at 280 nm (indicating an aromatic residue). What is the sequence of the heptapeptide?

Answer question 3 or 4 (16 points)

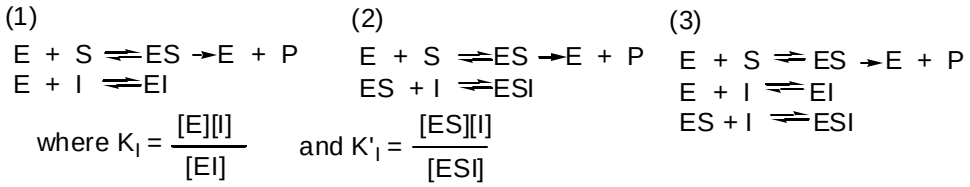
3. Aldolase catalyses the following reaction of glycolysis:

(a) Give the structures of the reactant and products of this reaction.

(b) $\Delta G^{o'}$ for this reaction is +23.9 kJ mol^{-1}. Calculate K', the equilibrium constant. (Assume T = 37 ^{o}C or 310 K)

(c) Calculate $\Delta G'$ for the reaction when fructose-1,6-diphosphate is 1.0×10^{-4} M, dihydroxyacetone phosphate is 4.0×10^{-5} M, and glyceraldehyde-3-phosphate is 2.5×10^{-6} M.

4. Following are three models for reversible inhibition:



(a) Identify each model by the **name** of the inhibition.

(b) Give the kinetic equation in the reciprocal Lineweaver-Burk form that corresponds to each model.

(c) Draw a Lineweaver Burk plot for each model, showing one line for the uninhibited reaction and a second line for a reaction containing inhibitor.

Answer question 5 or 6 (16 points)

5. You have prepared phospholipid vesicles containing K^+ at a concentration of 10 mM and you place them in a solution that is 50 mM in K^+. Adding either gramicidin or valinomycin to the solution will allow more K^+ to enter the cell, creating an electrical potential across the membrane (inside positive). ($T = 25^oC$, $F = 96.5$ kJ-V^{-1}-mol^{-1}; $R = 8.314$ J-K^{-1}-mol^{-1})
   (a) What will be the magnitude of the potential ($\Delta\Psi$) when the system comes to equilibrium?
   (b) You measure the rate of transport of K^+ with each antibiotic and find that transport with gramicidin is about the same at 25^oC and 15^oC, while the transport with valinomycin is much slower at 15^oC than at 25^oC. Explain this result in terms of the structure of the membrane and the mode of action of the two antibiotics.

6. Give the stepwise mechanism catalyzed by the enzyme **pyruvate dehydrogenase**, showing the partial structure of all the enzyme-bound intermediates. Identify the protein components catalyzing each step and the coenzymes involved as either cosubstrates or prosthetic groups.

Answer 7 or 8 (16 points)

7. In the conversion of glucose to pyruvate, three enzymes of glycolysis operate at concentrations of substrate and product removed from equilibrium, and these steps are sites of regulation. For each of the three steps, give:
    1. The **structure** of the reactants and products (names of coenzymes okay)
    2. The **name** of the enzyme.
    3. Metabolites or intermediates which **activate** and those which **inhibit** the enzyme.

8. In the oxidation of acetyl-CoA by the TCA cycle, three enzymes operate at concentrations of substrate and product removed from equilibrium, and these steps are sites of regulation. For each of the three steps, give:
    1. The **structure** of the reactants and products (names of coenzymes okay)
    2. The **name** of the enzyme.
    3. Metabolites or intermediates which **activate** and those which **inhibit** the enzyme.

9. (10 points) Put in the blanks the names or abbreviations for the amino acid or acids that:

_____contain sulfur.

_____have an amide in the side chain.

_____contain an aromatic alcohol.

_____contain an aliphatic alcohol..

_____migrate to the negative electrode at pH 8.5.

_____contain a second chiral carbon.

_____migrate to the positive electrode at pH 4.0.

_____form a peptide bond that is cleaved by trypsin.

_____form a peptide bond that is cleaved by cyanogen bromide.

_____contain an imidazole ring.

10. (6 points) Tell whether each of the following would **increase** or **decrease** the fraction of hemoglobin sites containing oxygen.

_____a decrease in pO_2.

_____an increase in [bis-phosphoglycerate].

_____dissociation into subunits.

_____an increase in pH.

_____an increase in $[CO_2]$

_____an increase in $[H^+]$.

11. (10 points) Identify by name the following carbohydrates or lipids:

_____the 2-epimer of glucose

_____a glycerophospholipid containing three glycerol molecules

_____an 18-carbon omega-6 fatty acid.

_____the disaccharide repeating unit of cellulose

_____the disaccharide repeating unit of amylose

_____the monosaccharide repeating unit of chitin

_____the 2-epimer of D-erythrose

_____the lipid formed when Phosphoryl-choline is attached to ceramide

_____a non-reducing disaccharide

_____the characteristic sugar which defines a ganglioside

12. (6 points) Draw the structures of guanine, cytosine, and thymine.

guanine **cytosine** **thymine**

13. (4 points) What is meant by Chargaff's rules?