BCH 4053 **HOUR TEST 3** **NAME____________________**
April 13, 2001

Points

(6) 1. Name the six classes of enzymes according to the International Commission on Enzymes:

Page	Points
1	____
2	____
3	____
4	____
Total	______

(6) 2. Following are a few enzymes we have studied. In the blank to the left of the enzyme, indicate which of the classes from question 1 that the enzyme would fall under.

_______________ chymotrypsin ____________________ phosphofructokinase

_______________ enolase ____________________ lactate dehydrogenase

_______________ phosphoglyceromutase ____________________ aspartic protease

(8) 3. Lysozyme catalyzes hydrolysis of the bacterial cell wall, cleaving the bond between muramic acid and N-acetylglucosamine. Asp-52, with a pK_a of 4.5, and Glu-35, with a pK_a of 5.9, are important functional groups involved in the catalytic mechanism. The pH optimum of lysozyme is 5.2.

(a) What accounts for the unusual pK_a of the glutamate residue?

(b) Which group will be protonated, and which unprotonated in the active enzyme?

(c) What role does the unprotonated group play in the catalytic mechanism?

(7) 4. Serine proteases involve a **catalytic triad** in the active site. Draw the structure of the amino acid side chains in this catalytic triad, showing how they interact with one-another.

(4) 5. (a) Explain the difference between coenzymes that are classified as **cosubstrates** and those classified as **prosthetic groups**.

(2) (b) To which class does NAD belong?

(4) (c) Name two enzymes you have studied for which NAD is a coenzyme.

(4) (d) Draw the structure of the reactive portion of NAD in both its oxidized and reduced forms.

6. Briggs and Haldane extended the model developed by Michaelis and Menten, but their modified model still predicted the same "Michaelis-Menten" equation.

(4) (a) Give the Michaelis-Menten equation:

(4) (b) What assumption of the Michaelis-Menten equation was modified by Briggs and Haldane, and what was the modified assumption? (State both assumptions first in words, and then as an algebraic expression).

(4) (c) How does the interpretation V_{max} and K_m, the two constants of the Michaelis-Menten equation, differ in the two models?

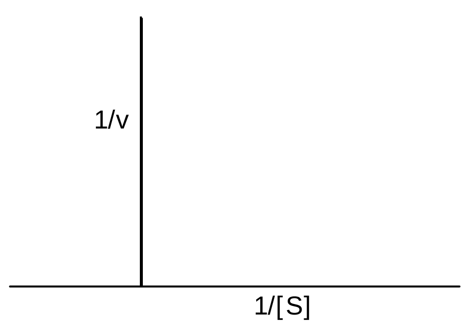
(9) 7. In your new job with the winery, you are purifying an enzyme from the grape extracts that catalyzes hydrolysis of ATP. Determining the kinetic constants of the pure enzyme, you find it has a V_{max} of 23.5 μmoles-min^{-1} per milligram of protein, and a K_m for ATP of 0.0035 M. To get these data, you measured the velocity at a number of ATP concentrations, including those shown in the table. What were the velocities you measured at these three ATP concentration? (Show your work

[ATP]	**v** **mmole-min^{-1}-mg protein**
1.2×10^{-4} M	
4.0×10^{-3} M	
5.5×10^{-2} M	

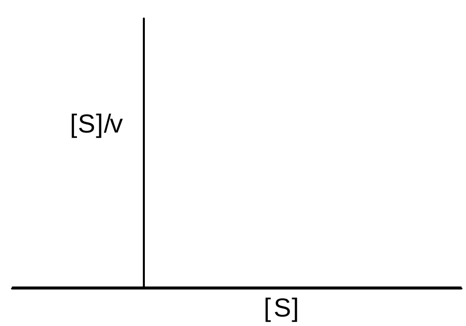
(10) 8. The Michaelis-Menten equation can be rearranged several ways in order to give a linear plot of the data. Two such graphs discussed in your book are the **Lineweaver-Burk** plot (1/v plotted versus 1/[S]) and the **Hanes-Wolff** plot ([S]/v plotted versus [S]). Give the **algebraically rearranged equation** for each of these plots, draw an appropriate line on each of the graphs below, and indicate on the graphs the values of the **x-intercept**, **y-intercept**, and **slope** of the line.

Equations:

Lineweaver-Burk



Hanes-Wolff



(8) 9. A number of structural variants of hemoglobin are known. For the following two variants, explain the structural difference from normal hemoglobin, and the consequence of this structural change on the properties of the molecule.

(a) Fetal Hemoglobin

(b) Sickle Cell Hemoglobin

(20) 10. Parts of the glycolytic pathway can mediate the catabolism of other substances. For example, hydrolysis of triglycerides in adipose tissue produces not only free fatty acids, but glycerol. The glycerol cannot be re-activated in adipose tissue, but can be taken up from the blood by liver, and there converted to pyruvate. The initial reactions of its metabolism in liver are the following:

glycerol + ATP Ž L- glycerol-3-phosphate + ADP

L- glycerol-3-phosphate + NAD^+ Ž dihydroxyacetone phosphate + NADH

(a) Give the overall pathway by which glycerol is converted to pyruvate, showing the **structures** of the carbon-compound intermediates. (Substrate coenzymes may be abbreviated).

(b) Starting with [sn 1-^{14}C] glycerol, circle the radioactive carbon of each intermediate, showing which carbon of pyruvate will become labeled.

(c) Give the overall stoichiometry of the reaction, showing the total production of ATP and NADH.