Name _____

I.D. _____

Score _____

Exam 3, BICH 440, Section 500, Monday, November 25, 2002

Write your name on each page. Write concise answers to demonstrate effectively your mastery of the subject. Show your work in order to receive maximum credit where applicable.

gas constant R 8.315 J/mol-K Faraday constant F 96.5 kJ/mol-volt

1) (8 pts) At what substrate concentration would an enzyme with a k_{cat} of 1000 sec^{-1} and a K_m of 4 mM show one-quarter of its maximum rate?

2) (7 pts) A sample of B-form DNA has a length of 15,000 bp and a linking number of +1400. Calculate the superhelical density, □, for this DNA.

Name _____

3) (6 pts) Draw the structure of a phosphorylated threonine sidechain at pH 7.

4) (10 pts) You are given the following data for initial velocity vs. substrate concentration for an enzyme-catalyzed reaction. The enzyme has a molecular weight of 60,000. Also, the turnover number, k_{cat}, for this enzyme under the same solution conditions is 30,000 sec^{-1}. From this data: (A) Determine the K_m for this substrate; and (B) determine the total amount of enzyme present in these experiments (in micrograms). You do not need to graph this data in order to answer this problem. Look at the data carefully and think.

substrate concentration (mM)	**initial velocity (micromole/sec)**
0.5	43
1.0	75
2.0	120
3.0	150
10.0	231
500	298
1000	299

Name _____

5) (6 pts) Circle the double-stranded DNA in each pair that has the LOWEST melting temperature.

A) 500 bp with 50% G+C composition in 0.1 M NaCl

OR

500 bp with 50% G+C composition in 0.1 M NaCl, 50% formamide

B) 500 bp with 25% G+C composition in 0.1 M NaCl

OR

500 bp with 25% A+T composition in 0.1 M NaCl

C) 500 bp with 40% G+C composition in 0.1 M NaCl

OR

20 bp with 40% G+C composition in 0.1 M NaCl

6) (9 pts) Predict whether each of the following alterations would increase/decrease/not change the amount of glycogen degradation in the liver. **Briefly justify your answer.**

A) mutation of serine residue to alanine in glycogen phosphorylase that is the site of reversible phosphorylation. The comparison is after glucagon addition to wild-type versus the ser□ ala mutant.

B) addition of epinephrine

C) In the absence of hormone addition, mutation of adenyl cyclase so that it is constitutively active.

Name _____

7) (8 pts) In a reaction, the starting concentration of A is 2 mM, and the concentration at various times during the reaction is given in the table. Using the graph paper below, determine whether the reaction is first-order or second-order with respect to A.

Time (min)	**[A], (mM)**
1.0	1.66
2.0	1.44
4.0	1.12
8.0	0.76
16.0	0.48

8) (10 pts) (A) Draw and label a reaction coordinate diagram for an uncatalyzed reaction (S □ P) AND a catalyzed reaction on the same plot. On your diagram, point out the overall exergonic free energy change for each reaction, the transition states, and the activation energies for both the uncatalyzed and catalyzed reactions.

(B) Write a mathematical expression that relates the rate constant and activation energies for a chemical reaction.

Name _____

9) (36 pts) Short answer

A) (3 pts) Draw the following RNA sequence in the most stable stem-loop structure (hint: ignore G-U base-pairs):

5′-GGAUUCGAACCCGAAUCC-3′

B) (4 pts) Briefly explain why the concentration of dATP exceeds that of ddATP in the "A-reaction" for dideoxy sequencing.

C) (3 pts) If you want to isolate a gene encoding a transfer RNA, would you start with a cDNA library or a genomic library? Explain your answer.

D) (2 pts) What is the extended length (i.e., no chromatin proteins) in nm or Angstroms for the DNA in a haploid yeast genome (1.3×10^7 bp)?

E) (3 pts) What is the advantage of using a thermostable DNA polymerase (e.g., Taq polymerase), instead of E. coli DNA polymerase in PCR?

F) (2 pts) What is a zymogen?

Name _____

G) (2 pts) Does an activator molecule increase or decrease the $K_{0.5}$ for a K-type allosteric enzyme?

H) (4 pts) What is the DNA and protein composition for a nucleosome core particle?

I) (4 pts) The iron associated with the heme group is coordinated with six atoms (molecules) in oxygenated hemoglobin. Account for these six (no structures necessary).

J) (5 pts) Write the Hill equation that relates the binding of oxygen to hemoglobin. Briefly define the variables and constants in this equation.

K) (4 pts) Fill in the blanks with "increases", "decreases", or "remains constant".

Upon addition of a competitive inhibitor, the effective K_m _____, and the effective V_{max} _____.

Upon addition of a pure noncompetitive inhibitor, the effective K_m _____, and the effective V_{max} _____.