CHEM 160A Final Exam Name _____
December 17, 2002

1) (4 points) What properties distinguish enzymes from other catalysts?

2) (10 points) Sketch transition state diagrams for a reaction with and without a catalyst. Label all parts of the diagram.

3) Studies at different pH's show that an enzyme has two catalytically important residues whose pKa's are ~ 4 and ~ 10.
   a) (4 points) Which amino acid residues are likely to play a part in this catalytic mechanism?

   b) (4 points) What type of catalytic mechanism is likely to occur in this enzyme?

4) (3 points) Explain why RNase A cannot catalyze the hydrolysis of DNA.

5) (4 points) Explain why an enzyme affects the rate of a reaction, but not the equilibrium of a reaction.

6) (12 points) Two enzymes bind to the same substrate and catalyze the same reaction. Enzyme A has a k_{cat} of 1.4×10^4 s^{-1} and a K_M of 1.0×10^{-4} M. Enzyme B has a k_{cat} of 1.4×10^4 s^{-1} and a K_M of 2×10^{-6} M. Comparing these two enzymes:

   a) Which enzyme has a greater affinity for this substrate?
      i) Enzyme A
      ii) Enzyme B
      iii) Both enzymes have the same affinity for this substrate.

   b) Which enzyme is better at catalyzing the substrate?
      i) Enzyme A
      ii) Enzyme B
      iii) Both enzymes catalyze this reaction the same.

   c) Which enzyme shows a greater efficiency with this substrate?
      i) Enzyme A
      ii) Enzyme B
      iii) Both enzymes have the same efficiency with this substrate.

7) (4 points) For the situations described below, use the following symbols to indicate whether V_{max} will increase (↑), decrease (↓), or remain constant (=).

a) In the presence of a mixed inhibitor: _____

b) After [S] has been doubled: _____

c) In the presence of a competitive inhibitor: _____

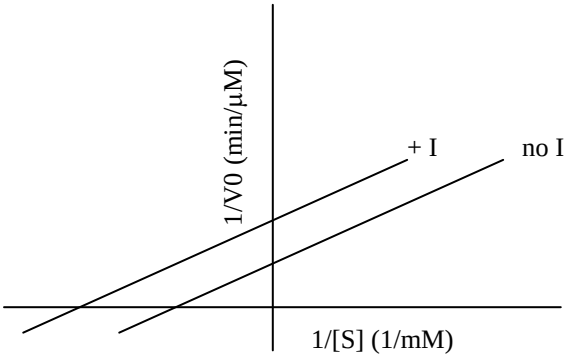
d) After the enzyme concentration has been doubled: _____

8) (4 points) The Lineweaver-Burk Graph below depicts an enzyme in the absence and presence of its inhibitor (I). What type of inhibitor is this?

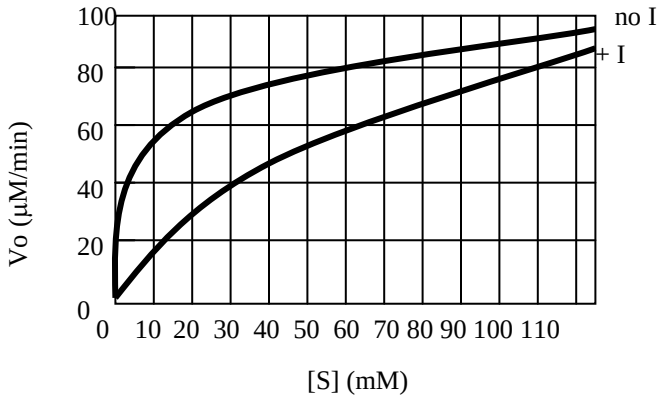
a) competitive

b) uncompetitive

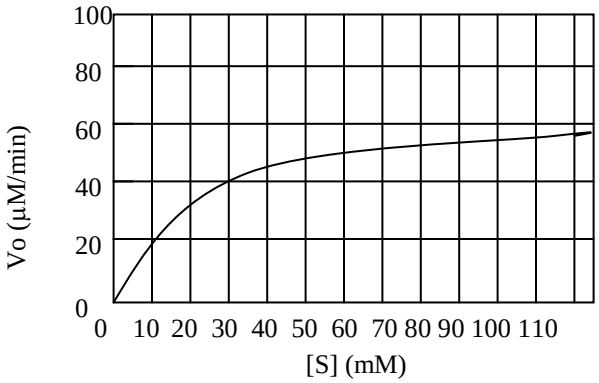
c) mixed



9) (4 points) The Michaelis-Menten Graph below depicts an enzyme in the absence and presence of its inhibitor (I).
Circle one -- Is this a competitive inhibitor, an uncompetitive inhibitor, or a mixed inhibitor?



For questions 10 through 13, refer to the Michaelis -Menten Plot below. This graph depicts the effects of increasing substrate concentration ([S]) on the initial rate of a reaction. The concentration of enzyme in this experiment was held constant at 0.1 μM.



10) (4 points) What is the approximate V_{max} of this enzyme with this substrate?

a) 60 mM
b) 30 μM/min
c) 60 μM /min
d) 100 μM/min

11) (4 points) What is the approximate K_m of this enzyme with this substrate?

a) 60 μM/min
b) 30 μM/min
c) 16 μM/min
d) 16 mM

12) (4 points) What is the approximate k_{cat} of this enzyme with this substrate?

a) 60 μM/min
b) 600 μM/min
c) 600 /min
d) 60 /min

13) (4 points) What is the approximate efficiency of this enzyme with this substrate?

a) 37.5 μM/(min-mM)
b) 60 μM/min
c) 37.5 /min
d) 60 /min

14) (4 points) Draw D-glucose in its linear form.

15) (1 point) Galactose is an epimer of glucose at carbon number _____.

16) (1 points) Mannose is an epimer of glucose at the carbon number _____.

17) Draw (4 points) Why are monosaccharides soluble in water?

18) (4 points) Draw α-D-ribose.

19) (5 points) Draw maltose.

20) (7 points) Draw sucrose.

21) (4 points) Suppose you had three polysaccharides, amylose, amylopectin, and glycogen, each with the same number of monosaccharide subunits. Which would be degraded the fastest, assuming that the enzymes acting to degrade the polysaccharide all worked at the same rate? **Explain your reasoning!**

22) (4 points) Structurally, what are the <u>similarities</u> between cellulose and amylose?

23) (4 points) Structurally, how does cellulose <u>differ</u> from amylose?

24) (4 points) Functionally, how does cellulose <u>differ</u> from amylose?

25) (6 points) Explain how the structural difference between amylose and cellulose contribute to their individual functions.

26) (4 points) How does life persist despite the second law of thermodynamics?

27) (3 points) When a protein is denatured, entropy
   a) increases
   b) decreases
   c) stays the same

28) (20 points) Calculate how much of each of the following reagents you will need to prepare 5.00 L of a 0.10 M carbonate buffer, pH 7.40.
H_2CO_3 has the following pKa's: $pK_1 = 6.35$; $pK_2 = 10.33$
Available reagents:

a) A stock solution of 0.50 M H_2CO_3
b) Solid $NaHCO_3 \bullet 3H_2O$ (MW = 138)
c) Solid $Na_2CO_3 \bullet 10H_2O$ (MW = 286)

29) (12 points) Draw an AU basepair, including hydrogen bonds. (You need only show the nitrogenous bases, not the backbone.)

30) (1 point) What is the difference between a nucleoside and a nucleotide?

31) (4 points) Biologically, why is it advantageous for DNA to be stable, but for RNA to be unstable?

32) (3 points) What is the most common form of double-stranded DNA in biological systems?

a) A-DNA
b) B-DNA
c) Z-DNA

33) (3 points) When the ionic strength of a DNA solution is increased, the melting temperature of the DNA

a) decreases
b) increases
c) remains the same

34) Use this table to answer questions (a) and (b).

Amino Acid	pK_{NH3+}	pK_{COOH}	pK_R
Aspartic Acid	9.90	1.99	3.90
Glutamic Acid	9.47	2.10	4.09
Serine	9.21	2.19	--

a) (10 points) Draw the tripeptide Asp-Glu-Ser at pH 7, showing each amino acid in the L-configuration.

b) (5 points) Calculate the isoelectric point for Asp-Glu-Ser. **Show your work for credit!**

35) (6 points) Which of the following amino acid residues would be likely to be in a protein that interacts ionically with DNA at physiological pH? (Circle all that apply.)

a) Tryptophan
b) Aspartic acid
c) Glutamine
d) Arginine
e) Histidine
f) Isoleucine

36) (6 points) Which of the following amino acid residues help bind a carbohydrate in the active site of an enzyme? (Circle all that apply.)

a) Tryptophan
b) Aspartic acid
c) Glutamine
d) Phenylalanine
e) Isoleucine
f) Histidine

37) (6 points) Which of the following amino acids are likely to be found in the interior of a protein? (Circle all that apply.)

a) Tryptophan
b) Aspartic acid
c) Glutamine
d) Arginine
e) Phenylalanine
f) Isoleucine