NAME _____

MMBB 380 - Fall 2002
EXAM 3 - PART I

You may use a calculator for this portion of the test. Hint: do not use the concentration of H_2O or H^+ in G calculations. The following are not necessary but may be used:

R = 8.314 J $K^{-1}mol^{-1}$ = 1.987 cal $K^{-1}mol^{-1}$ RT ln (x) = 5700 J/mol log (x)

(8 pts)

1) The following metabolite concentrations were determined for a particular cell.

Metabolite	Conc (M)	Metabolite	Conc (M)	Metabolite	Conc (M)
glucose	1.0×10^{-2}	Gly-3-P	1.0×10^{-4}	1,3-BPG	2.0×10^{-3}
Glc-6-P	1.0×10^{-4}	ATP	1.0×10^{-4}	3-PGA	1.1×10^{-2}
Frc-6-P	1.0×10^{-5}	ADP	2.0×10^{-3}	NADH	3.0×10^{-3}
Frc-1,6-BP	2.0×10^{-4}	P_i	1.0×10^{-3}	NAD^+	1.2×10^{-3}
DHAP	1.0×10^{-3}	H_2O	55.5	H^+	1.0×10^{-7}

a) Write the net balanced equation for the conversion of glucose-6-phosphate to fructose-1,6-bisphosphate using the glycolytic pathway. (Hint: this includes more than one glycolytic step)

b) Using the balanced reaction from part (a), determine the G for the glycolytic conversion of glucose-6-phosphate to fructose-1,6-bisphosphate (G^o = -21.7 kJ/mol for the net reaction).

(4 pts)

2) Given the following two balanced reactions, determine the G for the complete oxidation of one ethanol to two CO_2 molecules.

Glucose + 6 O_2 ⇌ 6 CO_2 + 6 H_2O G = -1637 kJ/nol

Glucose ⇌ 2 ethanol + 2 CO_2 G = - 218 kJ/mol

NAME _____

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EXAM III - PART II
You may not use a calculator for this portion of the test. Good Luck.

Page #	Points Possible	Points
Part I	12	
1	10	
2	10	
3	12	
4	9	
5	8	
6	11	
7	16	
8	12	
Bonus	4	
Total	100	

(3 pts)

1) Predicted by Pauling in 1946, transition state analogs have what effect on enzymes?

a. act as competitive inhibitors

b. act as noncompetitive inhibitors

c. act as irreversible inhibitors

d. do not act as inhibitors

(2 pts)

Briefly explain your answer to #1:

(5 pts)

2) The compound on the right is penicillin

a. Name or describe the function of the protein that penicillin acts on.

b. Illustrate how penicillin acts on this protein.

(3 pts)

3) In 1922, Fleming identified a bacterial lysis activity that was later attributed to the enzyme lysozyme. Which of the following is false?

a. lysozyme catalysis involves a carbonium ion

b. lysozyme catalysis is an example of general acid catalysis

c. H_2O is the first molecule to attack the glycosidic bond

d. lysozyme uses extensive hydrogen bonding to hold the carbohydrate residues in place

(3 pts)

4) Briefly explain how zymogens are involved with vertebrate digestive enzymes.

(4 pts)

5) Trypsin and chymotrypsin are serine proteases that share identical enzymatic mechanisms. Explain how and why they differ in *specificity*. Diagrams are strongly encouraged.

(12 pts)

6) Fill in all 6 stages of the serine protease catalytic mechanism as described in class. Include a short title or description that describes each stage.

(3 pts)

7) Which of the following regarding aspartic acid proteases is false?

a. the enzyme forms an acyl intermediate with the substrate

b. the HIV-1 protease is an aspartic protease

c. the active site contains two active site Asp residues

d. the mechanism yields hydrolysis of a peptide bond

(3 pts)

8) Ribozymes display substrate specificity. Explain and/or illustrate.

(3 pts)

9) Use this diagram to carefully show how a typical ribozyme would respond to changes in temperature. Label the y-axis.

(3 pts)

10) Which of the following regarding the molecular motor, kinesin, is false?

a. the speed that kinesin moves is dependent on the [ATP]

b. a single kinesin is capable of moving a microtubule (MT) in a gliding assay

c. some kinesins move toward plus ends of MTs while others move toward the minus ends

d. AMPPNP causes kinesin to dissociate from MTs

(3 pts)

11) Regarding the myosin cross bridge model of contraction identify which of the following events is in the correct chronological order.

a. binding of ATP, hydrolysis of ATP, release of ADP, power stroke, release of P_i

b. binding of ATP, hydrolysis of ATP, release of P_i, power stroke, release of ADP

c. binding of ATP, hydrolysis of ATP, power stroke, release of P_i, release of ADP

d. binding of ATP, hydrolysis of ATP, power stroke, release of ADP release of P_i

(2 pts)

12) Draw the Fisher projection of D-glyceraldehyde.

D-glyceraldehyde

(4 pts)

13) The most abundant disaccharide, sucrose, provides an example of an -1,2 glycosidic bond. The official name is *O*- -D-glucopyranosyl-(1→2)- -D-fructofuranoside. Draw sucrose.

(3 pts)

14) Catabolism is best described as

a. degradative pathways

b. biosynthetic pathways

c. mechanical pathways

d. energy requiring pathways

e. none of the above

(4 pts)

15) Draw the structure of MgADP

If MgADP was a substrate for adenylate kinase, what would the product(s) be?

(16 pts)

16) Fill in the missing second half of the glycolytic pathway. Include the glycolytic intermediate structures, enzyme names, and small molecules (ie ATP, H_2O, etc).

(6 pts)

17) Gluconeogenesis is the metabolic pathway where glucose can be synthesized from pyruvate. Gluconeogenesis uses some, but not all, of the glycolytic enzymes. Regarding only the 2nd half of glycolysis illustrated in the problem above, illustrate below only the gluconeogenic steps that differ from glycolysis. Be sure to take cellular geography into account. (lactate is not a source of pyruvate in this situation). Metabolite structures are not necessary.

(4 pts)

18) Glycolysis and gluconeogenesis are reciprocally regulated. Explain in terms of allosteric effectors; focus only on the step considered to be the commitment step in the glycolytic direction.

(2 pts)

19) If glycolysis is proceeding under anaerobic conditions, what are two important reasons why lactate dehydrogenase will be actively working?

(4 pts)

Bonus Question:

With respect to the 2002 Nobel Prize in Physiology or Medicine, explain each term & identify the individual responsible for that contribution.

Model organism:

Cell lineage:

Cell death: