

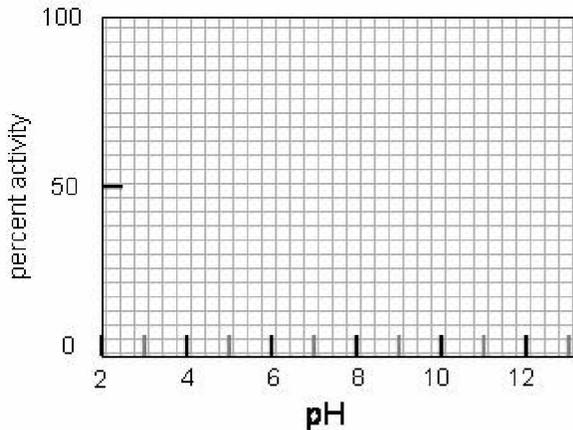
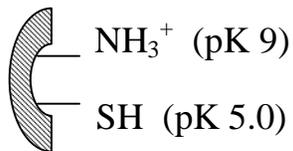
YOUR NAME: _____

NOTES:

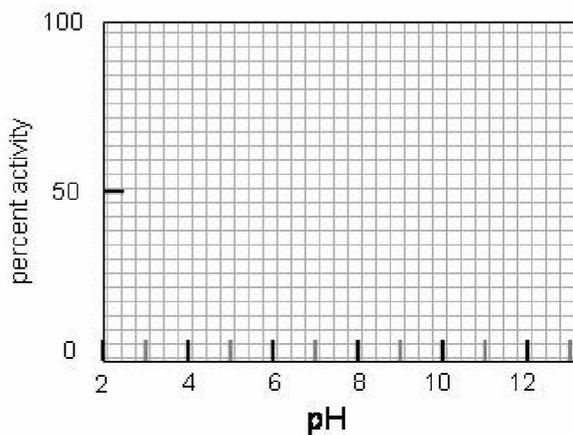
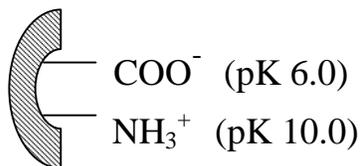
1. Where appropriate please show work – if in doubt show it anyway.
2. Pace yourself – you may want to do the easier questions first.
3. Please note the point value of questions – adjust your answers and effort accordingly.
4. Some questions may have more data than you need.
5. Please be brief – focus your answers to the space provided.
6. Please write CLEARLY – if I cannot read it – it is wrong.
7. You are welcome to detach the metabolic chart but please don't decimate your exam in the process.
8. Good luck.

Question 1 (6 pts.). Draw clear accurate graphs to describe the behavior of the following systems. Clarity and accuracy rewarded.

a. only the form of the enzyme show below is active. Show its pH dependence at the right.



b. only the form of the enzyme show below is active. Show its pH dependence at the right.

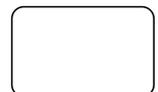


Question 2. (15 pts.). Short problems. Show work, but most credit goes to the correct numerical answer.

a. An enzyme has a V_{max} of $1.2 \mu\text{mol}/\text{min}$ and a rate of $0.12 \mu\text{mol}/\text{min}$ at 0.3 mM substrate. What is the K_m for the substrate $K_m = \underline{\hspace{2cm}} \text{ mM}$

b. In "a" above the molecular weight of the substrate and enzyme were 120 and $28,000 \text{ g/mol}$ respectively and the amount of enzyme used was $56 \mu\text{g}$. What is the maximal turnover number?

TN = $\underline{\hspace{2cm}}$ /min



c. A single subunit (monomeric) oxygen binding protein shows a K_p of 5 mm. What is the fractional saturation at 15 mm partial pressure of oxygen?

Fractional saturation _____

d. To answer this question, you will need some of the following: temperature = 37 °C; the oxygen concentration dissolved in pH 7.4 buffer in equilibrium with air is 0.22 mM; hemoglobin is saturated with oxygen at this concentration

One liter of solution containing 2×10^{-3} mol hemoglobin is gently stirred in air until equilibrium is reached. What is the total concentration of oxygen in the solution?

Total concentration = _____ M

What is the free concentration of oxygen in this hemoglobin solution = _____ M

Question 3 (5 pts.). What is the effect of the following on hemoglobin or myoglobin. Circle the most appropriate answer. NC = no change.

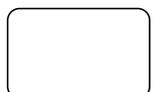
Increasing pH on the oxygen affinity of hemoglobin *increase* *NC* *decrease*

Decreasing pH on CO₂ binding to hemoglobin *increase* *NC* *decrease*

Decreasing pH on DPG affinity of hemoglobin *increase* *NC* *decrease*

Increasing DPG levels on CO₂ affinity of hemoglobin *increase* *NC* *decrease*

Increasing DPG levels on O₂ affinity of myoglobin *increase* *NC* *decrease*



Question 4 (8 pts.). Given the following calculate ΔG° for equation 1:



In equation 1 ... To make ΔG more negative I would: circle all of the following which will definitely accomplish this:

1. increase the concentration of A
2. decrease the concentration of A
3. increase the concentration of C
4. decrease the concentration of C
5. increase the temperature
6. decrease the temperature
7. lower the pH
8. increase the pH
9. add the enzyme that catalyzes the reaction: C \leftrightarrow A
10. Dilute the mixture of C and A with an equal volume of water.

Question 5 (5 pts.). Draw the structure of a chemically-credible reversible inhibitor of an HIV-protease. Circle the functional group that is the key aspect of the anticipated inhibition.

Now explain the key feature of the proposed inhibitor:



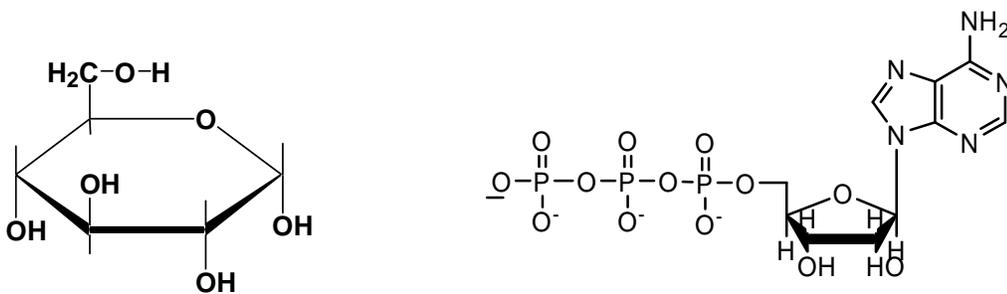
Question 6 (8 pts.). Linked equilibria. Suppose that an enzyme is a trimer of identical subunits in equilibrium with monomers. The two substrates of the enzyme X and Y bind 5 times more tightly to the monomer. The trimer is 10-times more active than the monomer. An allosteric molecule binds preferentially to the trimer. Finally dissociation of trimer to monomers releases 3 protons into solution at pH 7.

Circle the most appropriate answer for the following. What is the effect of:

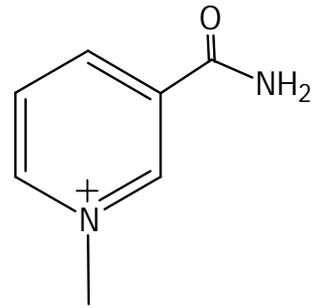
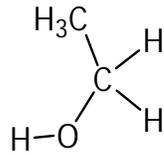
- | | | | |
|----------------------------------------------------------------------------|----------|----|----------|
| a. Increasing [Y] on extent of monomers | increase | NC | decrease |
| b. Lowering pH to 6.0 on percentage of trimer | increase | NC | decrease |
| c. Raising the concentration of the allosteric molecule on enzyme activity | increase | NC | decrease |
| d. Lowering total enzyme concentration on the percentage of trimer | increase | NC | decrease |

Questions 7 (8 pts.). For the following two parts. Place the name of the relevant enzyme in the space and draw a curved arrow representation of the reaction it catalyzes.

a. Enzyme name _____



b. Enzyme name _____



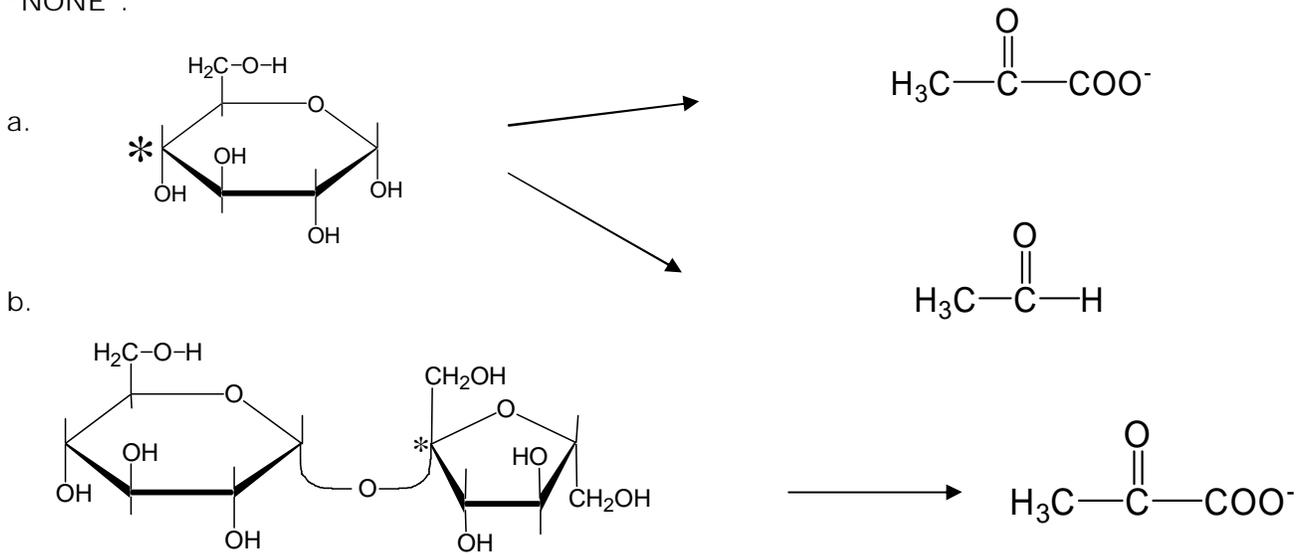
Question 8 (6 pts.). Yield of ATP. In the space provided give the yield of ATP that would be formed in the following processes (enter a number from 0-10):

a. per molecule of dihydroxyacetone phosphate to ethanol _____

b. per molecule of fructose 6-P converted to lactate _____

c. per molecule of fructose converted to ethanol _____

Question 9 (8 pts). Tracing radiolabels and *etc.* Place asterisks indicating the position of the radiolabel in the molecules shown to the right – if the product contains no radiolabel write "NONE".

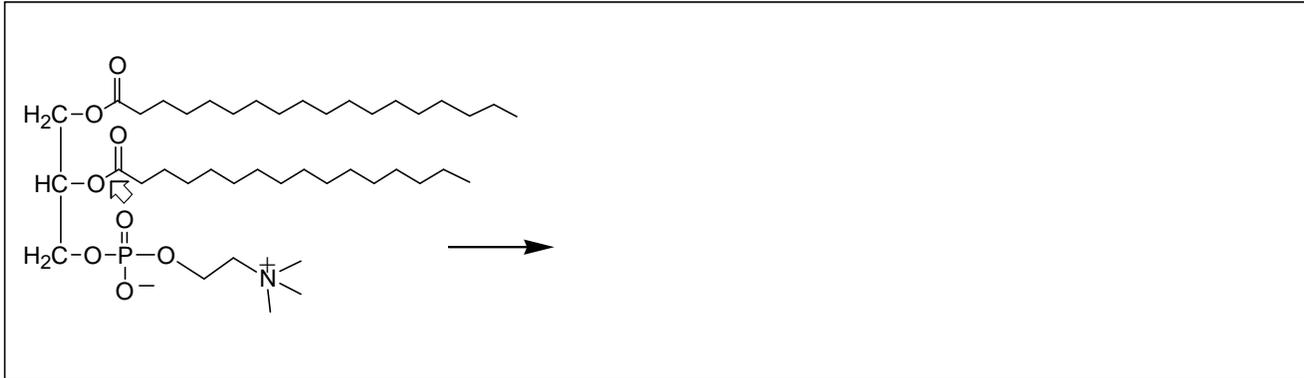


c. In disaccharide "b" number on the structure the carbon marked with an asterisk

d. In disaccharide "b" name the glycosidic linkage _____



Question 10 (10 pts.). Phospholipase A2 catalyzes the breakdown of molecules like the one shown in the box below by attacking the indicated position. Complete the equation with all other reactants and products of the reaction.



When phospholipase A2 is added to a solution of vesicles (a vesicle is a self-sealed bag of membrane as shown to the right) made up of the substrate shown in the box ... the vesicles remains intact. Explain why only 50% of the substrate is converted to product.



Two lines only:

If you did FRAP experiments before and after phospholipase treatment what would you expect:

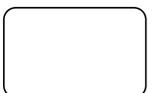
Question 11 (4 pts.). The osmotic pressure of 1 mL of a 0.1 M solution of glucose is 2.4 atmospheres (about 36 pound per square inch).

a. Calculate the new osmotic pressure if the same amount of glucose were found in 1 mL of amylose (containing 10,000 glucose units per amylose molecule).

= _____ atmospheres

b. Calculate the new osmotic pressure if the same amount of glucose were found in 1 mL of glycogen (again containing 10,000 glucose units per glycogen molecule).

= _____ atmospheres



Question 12 (16 pts.). Fill in the blanks with not more than 3 legible words.

a. name an irreversible inhibitor of an enzyme _____

b. and the enzyme that is the target of your answer in "a" _____

c. these enzymes do not follow Michaelis-Menten kinetics _____

d. an example of a biological wax _____

e. the water-soluble vitamin incorporated into NAD⁺ is called _____

f. accumulation of a solute across a biological membrane is called _____

g. a negative allosteric regulator of glycolysis _____

h. this process ultimately limits the catalytic efficiency of enzymes _____

i. a major regulatory enzyme in glycolysis _____

j. the monosaccharides D-glucose and D-galactose are ____
of one another _____

k. name a ketotriose _____

l. a metal frequently associated with kinases _____

m. a non-saponifiable lipid found in mammalian cell membranes _____

n. a hormone that indirectly activate phosphorylase _____

z. how many times have you been taught "glycolysis" _____

zz. the word that best describes this exam _____

