Chem. 452, 2000(blue) # EXAM 2

NAME_____ .

I. Multiple choice-Circle the *best* answer(3 pts each)

1. In the Bohr effect, the binding of oxygen to hemoglobin

a) is increased by the presence of Na+
b) is increased by the presence of H+ and CO_2
c) is decreased by the presence of H+ and CO_2
d) is unchanged

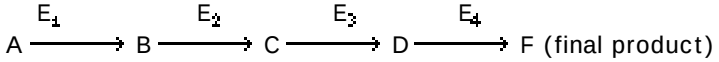
2. The binding of oxygen to hemoglobin differs from the oxygen-binding behavior of myoglobin because

a) oxygen binding to hemoglobin is cooperative
b) oxygen binding to myoglobin is cooperative
c) hemoglobin is not an allosteric protein
d) the oxygen-binding curve of hemoglobin is hyperbolic

3. According to the steady-state assumption

a) the product concentration does not change significantly
b) the substrate concentration is large and does not change significantly
c) the concentration of enzyme-substrate complex remains constant with time
d) the free enzyme concentration is always in great excess to the concentration of enzyme-substrate complex

4. Many metabolic pathways involve multistep reactions. Consider the following pathway.



Feedback inhibition is usually associated with

a) the product of the final reaction, F, interacting with E1
b) F interacting with an allosteric site in E4
c) B interacting with an allosteric site in E1
d) all of the intermediates or products in the reaction interacting with the active site in E4

5. The initial bond formation in the covalent intermediate in the reaction catalyzed by chymotrypsin is between

a) serine and the carbonyl carbon in the peptide backbone
b) serine and the nitrogen in the peptide backbone
c) histidine and the carbonyl carbon in the peptide backbone
d) histidine and the nitrogen in the peptide backbone

6.The degree of membrane fluidity usually depends on

a) the percentage of lipids that contain choline
b) the percentage of glycolipids

c) the percentage of fatty acids
d) the percentage of unsaturated fatty acids

7. In the sodium-potassium pump

a) sodium is transported out of the cell and potassium into the cell, both against concentration gradients
b) sodium is transported into the cell and potassium out of the cell, both against concentration gradients
c) sodium is transported out of the cell and potassium into the cell, both in the same direction as concentration gradients
d) sodium and potassium are both transported out of the cell against concentration gradients

8. A reaction has a ΔG^o =-200 kJ/mol . What can be predicted about the kinetics of the reaction?

a) will exhibit rapid kinetics
b) will exhibit slow kinetics
c) the kinetics can't be predicted until the concentrations of products and reactants are known
d) the kinetics can't be predicted from this information

9. Sunbstrates with a larger K_m generally have a_____ affinity for the enzyme as compared to sunbstrates with a smaller K_m.

a) greater
b) lesser
c) same

10. Hemoglobin F (fetal) would be expected to have a _____affinity for O_2 than the mother's.

a) lower
b) higher
c) the same

11. "Stripping" bisphosphoglycerate from hemoglobin:

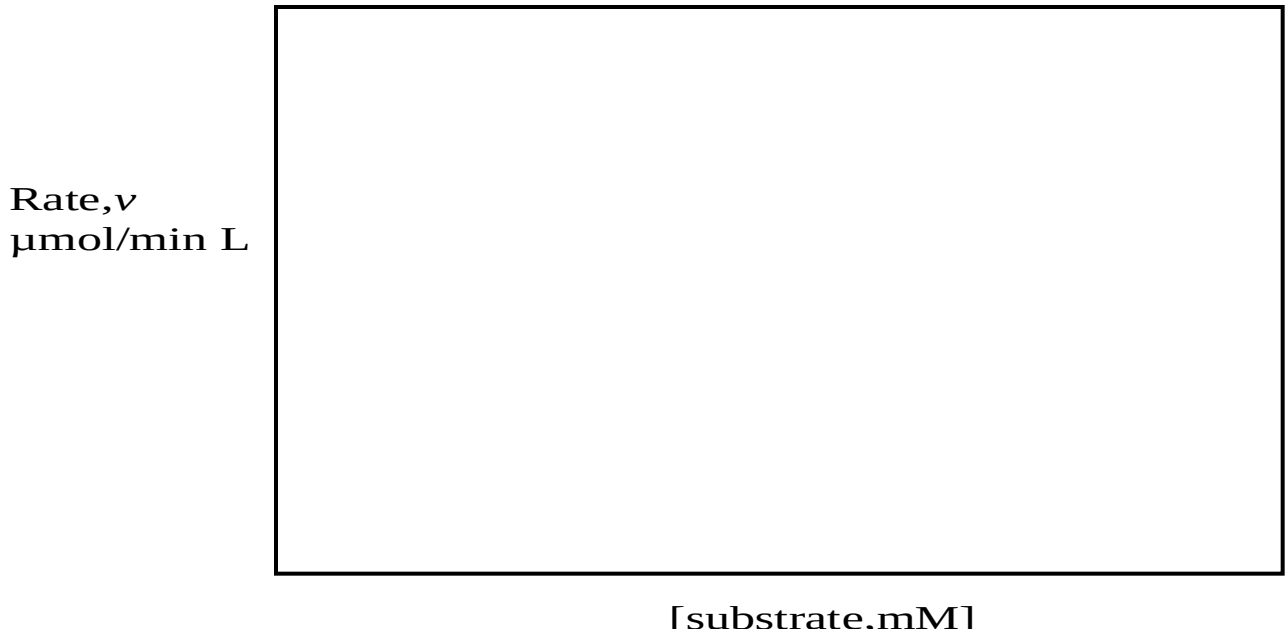
a) increases the positive oxygen binding cooperativity
b) decreases the positive oxygen binding cooperativity
c) increases P_{50}
d) decreases P_{50}
e) a and c
f) b and d

12. Under standard conditions, the hydrolysis of ATP can be used to drive a reaction whose ΔG^o is:

a. greater than +30.5 kJ/mol
b. less than +30.5 kJ/mol
c. between +20 and +40 kJ/mol
d. cannot be determined unless the temperature is known

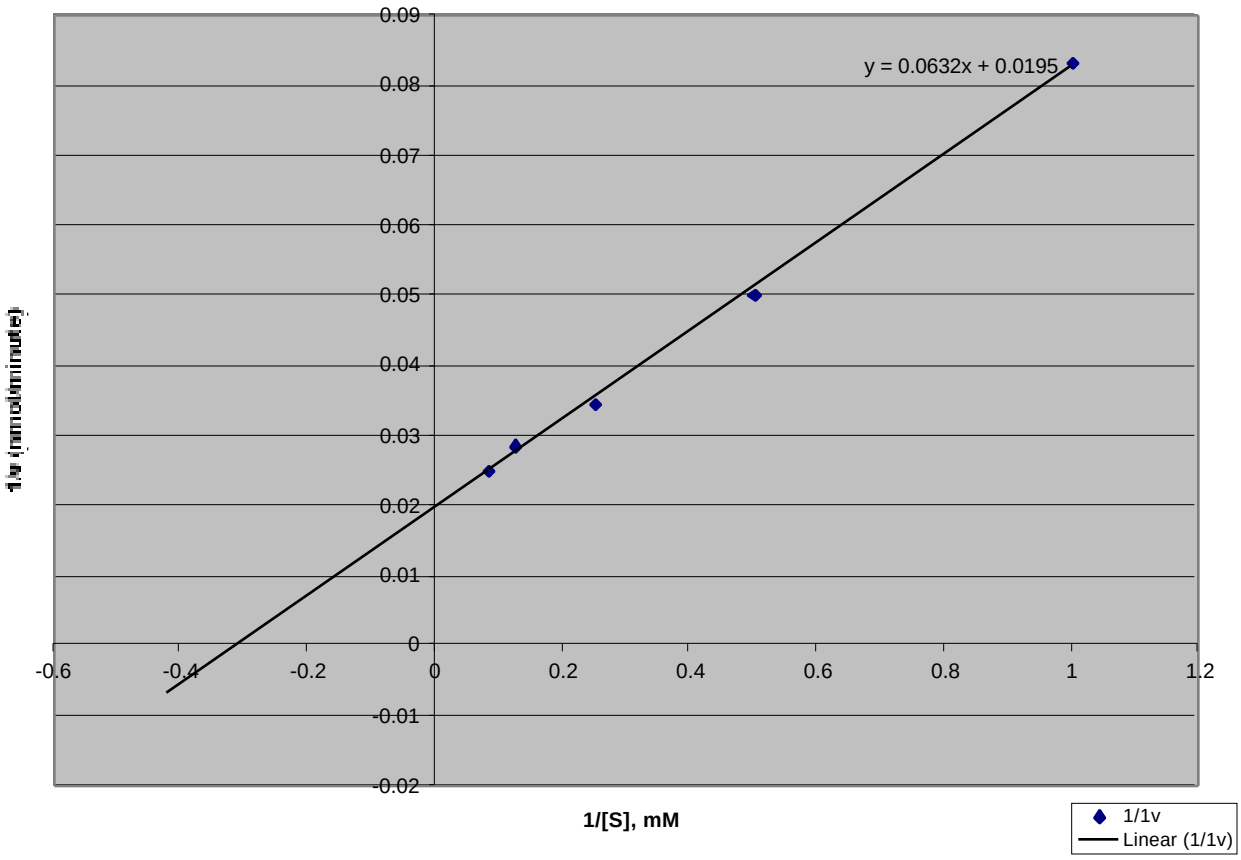
II.Problems, etc-Show all work to receive any credit

13. An interaction between a protein and a DNA sequence has a ΔG^{o} =-55.8 kJ/mol. What is the equilibrium constant at 37 ^{o} C for this DNA-protein interaction?(5)



14. In the graph above, draw a line representing *v* vs.[S] for **A)** an enzyme exhibiting Michaelis-Menten behavior **B)** the SAME enzyme in the presence of a non-competitive inhibitor **C)** the SAME enzyme in the presence of a competitive inhibitor (8) **Label Clearly**

15. Estimate the V_{max} and the K_m of the enzyme catalyzed process below(8)



16. A recent article in ***Science*** claims researchers have discovered a new biochemical reaction that is the first step in the glycolytic pathway in certain bugs. It is shown below:

glucose + glycerol-3-phosphate ⟷ glucose-6-phosphate + glycerol

a. Is this reasonable (spontaneous) under standard conditions? Show why or why not.

16b. The normal reaction is :

glucose + ATP ⟷ glucose-6-phosphate + ADP

What is the ΔG^{o} for this reaction?

c. When you read farther in the article you find that under cellular conditions in the bug [glycerol] =1.0 mM; [glycerol-3-phosphate]=20.0 mM; [glucose]=5 mM; [glucose 6-phosphate]=0.0050mM. Temp=37C. pH=7.0. What is the ΔG for the reaction under these conditions? Does this new information make the original claim more or less reasonable? (15)) Explain

17. Draw a choline sphingomyelin made with *cis* 9-hexadecenoic acid. (6)

18. a.What is the $\Delta G'$ for transport of Cl^- ion from the inside to the outside of a neuron ? (15)
Assume Cl^-_{inside}= 92 mM, $Cl^-_{outside}$=120 mM, T=37 C, membrane potenital=0 mV

b. What would the $\Delta G'$ be if there was a -70. mV (inside negative) membrane potential?

c. If (b) corresponds to the real situation, is Cl- transport out of the cell a spontaneous process? Why or why not?

19) Discuss the "advantage" gained by carrying one gene for sickle cell anemia (HbS). Now explain the down side of the mutation, particularly for those carrying two copies of the gene. Be sure to discuss protein structural/aggregation changes and what conditions precipitatethem(no pun intended) .(**7)**

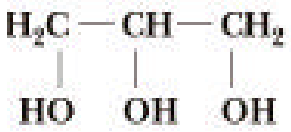
BONUS: Concerning problem 18b: Would it be feasible to synthesize ATP by coupling to Cl^- transport? How many moles of Cl^- would it take to synthesize a mole of ATP (under std conditions)?

$$A + B \rightarrow C + D$$

$$\Delta G^{o\prime} = -RT\ln\left(\frac{[C][D]}{[A][B]}\right)$$

$$\text{defining } K'_{eq} = \left(\frac{[C][D]}{[A][B]}\right)$$

$$\Delta G^{o\prime} = -RT \ln K'_{eq}$$



Glycerol

Gas Constant: R = 8.3145 J(K-1)(mol-1); R = 1.987 cal(K-1)(mol-1) Faraday: F = 96,485 J(V-1)(mol-1); 1 cal = 4.184 J

Lipid Head Groups

ethanolamine

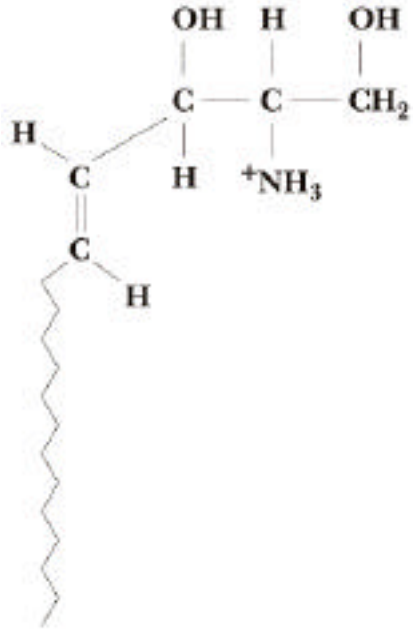
$-OCH_2CH_2NH_2$

choline

$-OCH_2CH_2\overset{+}{N}(CH_3)_3$

serine

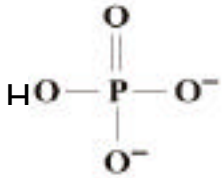
$-OCH_2\underset{\underset{NH_3^+}{|}}{C}HCO_2^-$



Sphingosine

$$\Delta G = \Delta G^{o\prime} + RT \ln\left(\frac{[C][D]}{[A][B]}\right)$$

$$\Delta G = R\,T \ln\left(\frac{[S]_2}{[S]_1}\right) + Z\,F\,\Delta\Psi$$



$\Delta G^{o'}$ of phosphate hydrolysis (kJ/mol)

Compound	
Phosphoenolpyruvate (PEP)	- 61.9
Phosphocreatine	- 43.1
Pyrophosphate	- 33.5
ATP (to ADP)	- 30.5
Glucose-6-phosphate	- 13.8
Glycerol-3-phosphate	- 9.2

$$v = \frac{V_{\max}[S]}{K_M + [S]}$$