Name _____

Chem 352 - Fall 2018 - Exam II

Some potentially useful information:
Ideal gas law constant, $R = 8.314$ *J/(mol•K)* = 0.08206 *(L•atm)/(mol•K)*
Faraday's constant, $F = 9.469 \times 10^4$ *J/(mol•V)*

1. D-Maltose is a disaccharide comprising two molecules of the monosaccharide D-glucose. In solution, D-glucose is present primarily in two pyranose ring forms; 36% in the α-D-glucopyranose form, and 64% in the β-D-glucopyranose form. In solution, D-glucose will convert rapidly between these two ring forms by passing through and open-chain form, which at any instance in time is present in only very small quantities.

   a. In the space below, illustrate this equilibrium reaction using Haworth projections for the α-D-glucopyranose and β-D-glucopyranose structures, and a Fischer projection for the open chain form.

~36% α-D-glucopyranose
Haworth projection

< 1% α-D-glucose
Fischer projection

~64% β-D-glucopyranose
Haworth projection

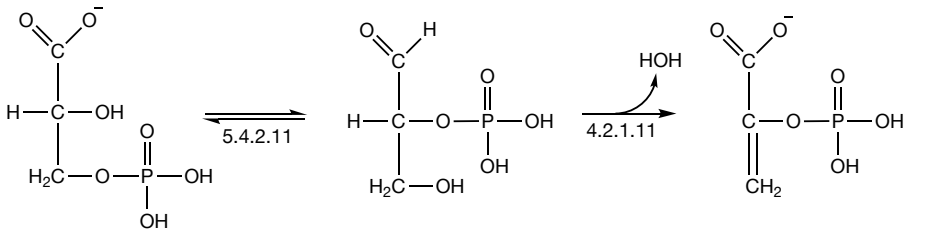
   b. Using Haworth projections, draw the structure of the β-anomer of D-maltose.

β-D-Maltose

   c. While one of the glucose residues in maltose can be found in either its α or β anomer ring form, the other is only found in its α-anomeric ring form. Explain why this is.

   d. D-Maltose represents the disaccharide unit of a much larger homopolymer of D-glucose. Name this polymer and describe its biological function.

2. Shown below are two consecutive reactions in the glycolytic pathway,



3-phosphoglycerate *2-phosphoglycerate* *phosphoenolpyruvate*

a. The two enzymes that catalyze these reactions are identified above by their Enzyme Commission numbers. Indicate which class of reaction each of enzyme catalyses.

   i. E.C. 5.4.2.11_____

   ii. E.C. 4.2.1.11_____

The kinetics for both these enzymes were studied at an enzyme concentration of 150 nM and the follow values for K_M and V_{max} were obtained from Lineweaver-Burk plots.

	5.4.2.11	**4.2.1.11**
K_M	6.5 mM	43 μM
V_{max}	477 mM/min	72.1 mM/min

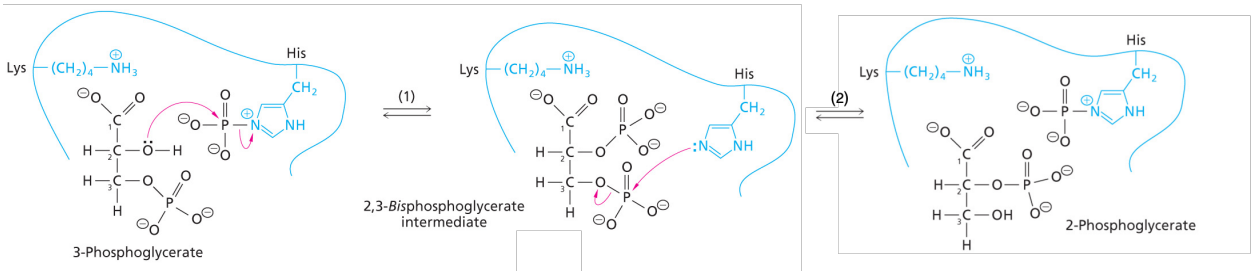
b. Which of these enzymes is capable of catalyzing more reactions per second than the other when fully saturated with substrate?_____
What is your evidence for this claim?

c. Which of these enzymes requires a higher concentration of substrate in order to be fully saturated with substrate?_____
What is your evidence for this claim?

d. Do one or both of these enzyme demonstrate *catalytic perfection*?
   i. 5.4.2.11 (Y/N)?_____, 4.2.1.11 (Y/N)?_____
   What is your evidence for these claims?

   ii. What does it mean for an enzyme to demonstrate catalytic perfection?

e. Shown below is a diagram illustrating the catalytic mechanism for the reaction catalyzed by the enzyme 5.4.2.11



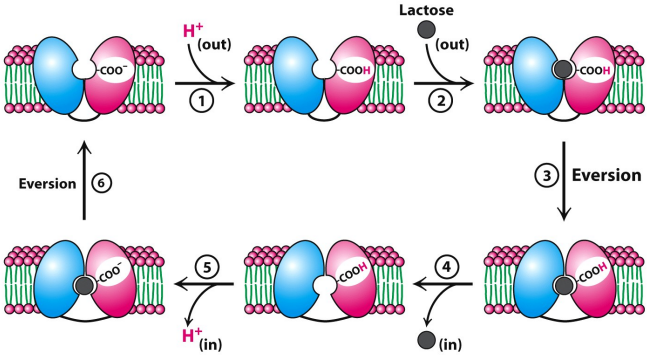
i. What catalytic role is being played by the histidine side chain?_____
Explain your reasoning:

ii. What catalytic role is being played by the lysine side chain? _____
Explain your reasoning:

3. Draw the structure of the phospholipid *phosphotidylcholine* containing a palmityl (16:0) acyl group at the C1 position, and a linoleyl (18:2, *cis*-$\Delta^{9,12}$) acyl group at the C2 position.

a. In a couple of sentences, describe the structure that forms spontaneously when phosphotidylcholine is mixed with water. Include in this description a mention of the intermolecular interactions that lead to the formation of this structure.

4. *Lactose permease* is an integral membrane protein that transports lactose across bacterial cell membranes along with hydrogen ions. The transport cycle is illustrated in the diagram below.



a. What kind of transport is this an example of? *uniport*, *symport* or *antiport*? _____

b. Given the membrane potential $\Delta\Psi$ (Ψ_{in} - Ψ_{out}) is -65 mV, is the transport of lactose into the cell favorable at 37°C if on the outside the *pH* is 6.4 and the concentration of lactose is 0.035 mM, while on the inside the *pH* is 7.6 and the concentration of lactose is 1.00 mM? _____
Give your evidence for this claim:

c. If the transport of lactose into the cell is favorable, is this is this an example of *active* or *passive* transport? _____
Explain:

d. What class of biological molecule, *e.g.*, *amino acid*, *carbohydrate*, *lipid*, *etc.* does lactose belong to? _____

e. Draw the chemical structure for α-D-lactose.

α-D-lactose

f. What two monosaccharides comprise α-D-lactose?

_____

_____

g. How many chiral carbons does α-D-lactose possess? _____

h. What type of *glycosidic bond* connects the two monosaccharides? _____