Name ___________________________________

Chem 352 - Spring 2018 - Exam II

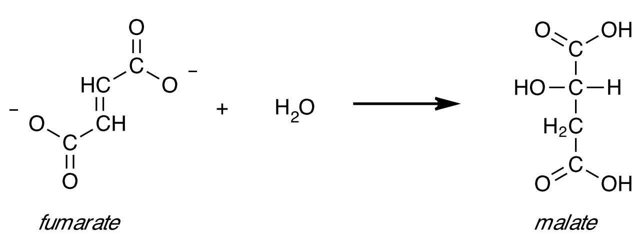
1. Honey is an solution of D-fructose and D-glucose monosaccharides. Although when D-fructose is present in polysaccharides it exists mainly in its furanose form, in solution monomeric D-fructose is a mixture of several forms, with β-D-fructopyranose (67%) and β-D-fructofuranose (25%) being the predominant forms.

   a. Draw the Fischer projection for the monosaccharide D-fructose and show, using Haworth projections, how D-fructose can cyclize to form both β-D-fructopyranose and β-D-fructofuranose.

   b. β-D-fructofuranose is one of the two monosaccharides found in the disaccharide sucrose. Draw the the structure for sucrose.

   c. Why can D-fructose be found in multiple cyclic forms as a monomer in solution when it is only found in the β-D-fructofuranose form in the disaccharide sucrose.

2. One of the steps in the citric acid cycle is the conversion of fumarate to malate. This reaction is catalyzed by the enzyme *fumarase*:



In a kinetics experiment where the fumarase concentration is set at 200 μM, the *turnover number* is observed to be 5.0×10^5/s and the K_M is observed to be 50 mM.

   a. What is the catalytic rate constant, k_{cat}, for this reaction? ______________________ (*Show your calculations*.)

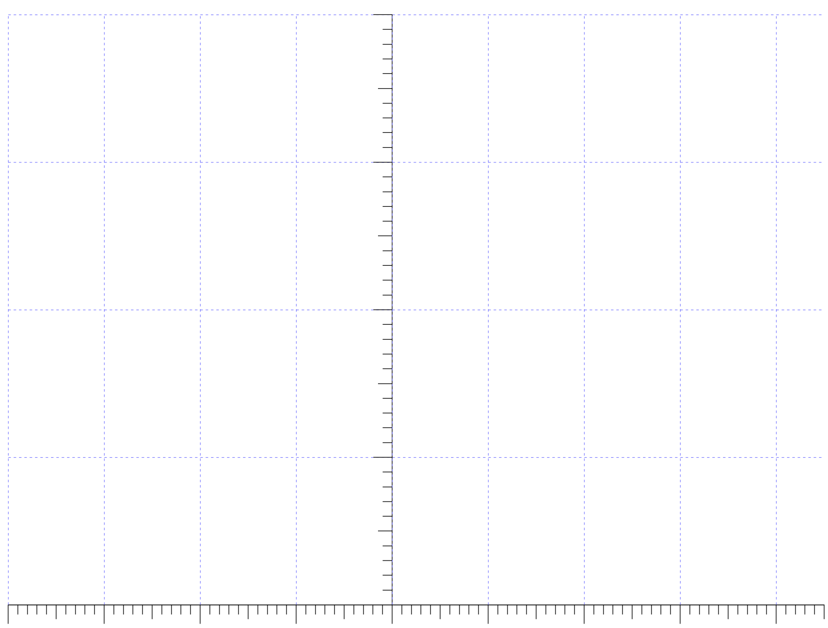
b. What is the expected V_{max} for this reaction? ______________________
(*Show your calculations*.)

c. Which class of *enzyme catalyzed reaction* does fumarase belong to? __________________________

d. Under these conditions, does fumarase display “catalytic perfection” _________________________
(*Show your calculations*.)

e. When an enzyme displays “catalytic perfection”, what physical constraint has been placed on the enzyme’s ability to increase rate of the reaction.

f. Using the axes drawn below, sketch the expected *Lineweaver-Burke Plot* for this experiment. (Be sure to label your axes, including units)



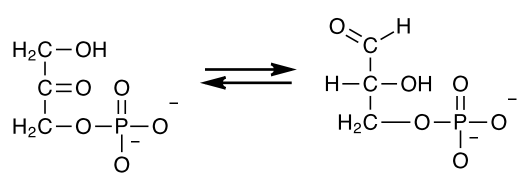
g. On the same graph, sketch the result expected in the presence of an inhibitor that increases the K_M to 100 mM but has no effect on V_{max}.

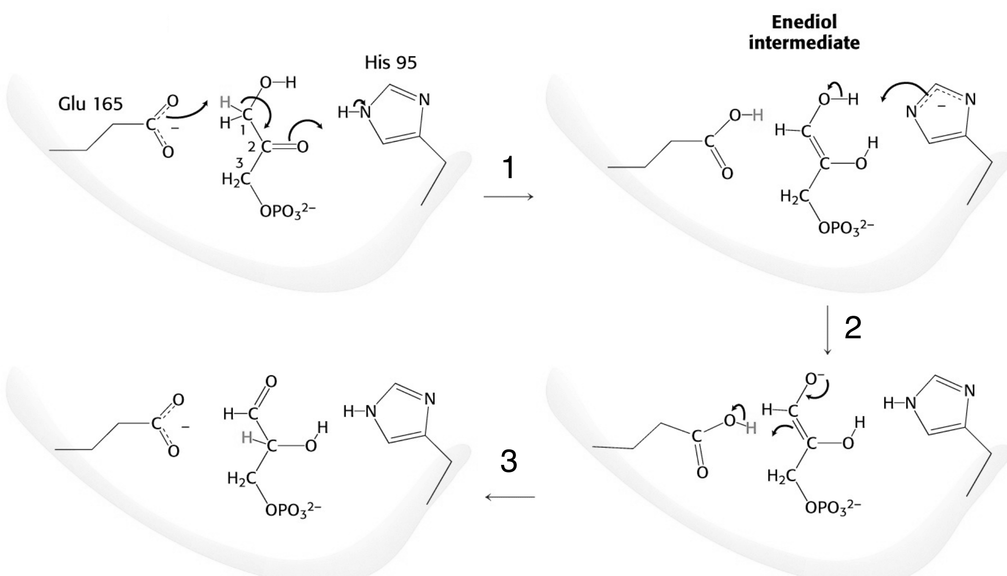
h. Describe where the inhibitor likely binds to the enzyme, relative to the substrate.

3. Draw the structure of the phospholipid *phosphotidylserine* containing a stearyl (18:0) acyl group at the C1 position, and a palmitoleyl (16:1, *cis*-Δ^9) acyl group at the C2 position.

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

4. Below is a figure illustrating the active site of an enzyme found in the glycolytic pathway. The enzyme catalyzes the following reaction,





a. What class of biological molecule, *e.g.*, amino acid, carbohydrate, lipid, *etc.* does the reactant in this reaction belong to? ________________________

b. What is the name of the product for this reaction?__________________________

c. What class of enzyme does this enzyme belong to? ______________________

d. What catalytic role does *His 95* play in step 2 of this reaction? ____________________

e. What catalytic role does *Glu 165* play in step 3 of this reaction? ______________________

5. *Amylose* and *cellulose* are both polymers of D-glucose, however their chemical and physical properties are quite distinct.

   a. In a couple of sentences, describe some of the structural and physical differences between amylose and cellulose. Also include in this discussion how these differences relate to biological roles played by these two polysaccharides.

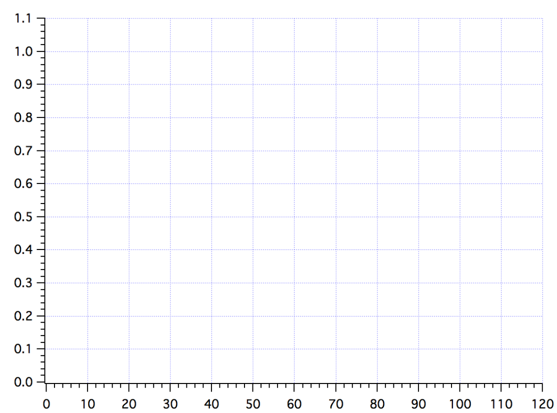
6. Myoglobin (Mb) and hemoglobin (Hb) are both oxygen binding proteins.

   a. Though both proteins bind oxygen, they do so for different reasons. In mammals, describe the role that each protein performs when binding oxygen.

   Mb:

   Hb:

   b. On the graph to the right, sketch and label the oxygen binding curves, fraction bound (Y) *vs.* partial pressure of oxygen in *torr* (pO_2), for Mb with a P_{50} of 10 torr and Hb with a P_{50} of 30 torr. Be sure to label the axes.



   c. Given the pO_2 is 100 torr in the lungs and 26 torr in the tissues, explain how the differences in the binding behaviors for Mb and Hb shown in the graphs above best suites each to the roles you described in part a.