CHEM106 Test 3
Monday, November 25, 2019

Name: Key

Follow the directions for each section and answer what you are asked succinctly, neatly and as specifically as you can.

Section 1: Rules

1) (10 points) Write out the following:
   a. Rules for mechanisms that I taught you

① CHP = electrophiles
NOS = Nucleophiles

② Know the substrate and the products

③ Find the nucleophile (neg. charge or lone pair) and attack the electrophile

   b. Rule for the chemical structure of α-D-glucose

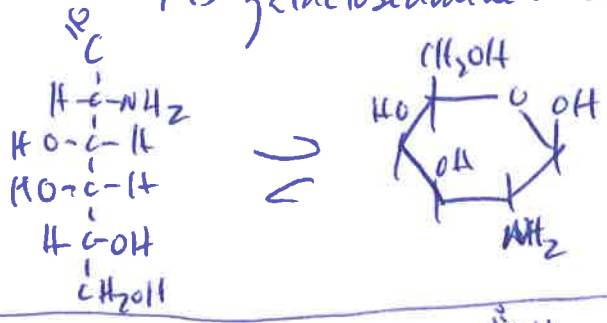
DDuDu

Section 2: Sugars

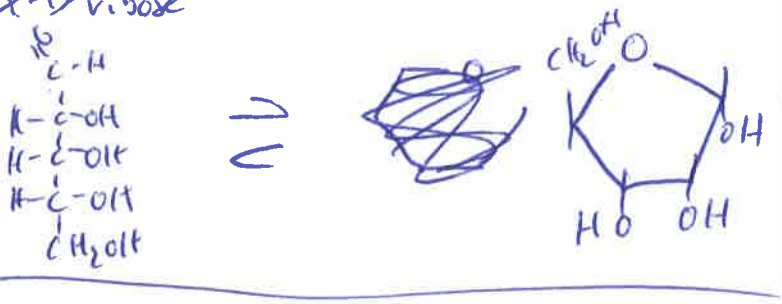
2) (10 points) Draw the Fisher projection and the Haworth projection for one of the following sugars. Write the name of the sugar under the Haworth projection.

Your choices are: β-D-galactosamine, α-D-ribose, β-D-mannose

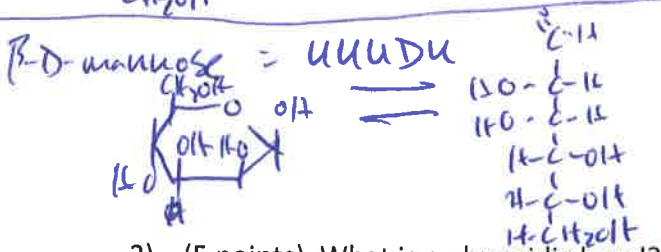
β-D-galactosamine = UDUUU w/ NH_2 @ C-2



α-D-ribose



β-D-mannose = UUUDU



3) (5 points) What is a glycosidic bond?

A glycosidic bond is an ether bond ~~bw~~ an R-group and a hydroxyl of a monosaccharide

4) (5 points) Draw **one** of the following disaccharides: maltose, sucrose, trehalose, lactose, cellobiose. Write the name of the disaccharide underneath it, making certain to include the linkage in the name.

Maltose: α-D-glucose-(1→4)-α-D-glucose

Sucrose: β-D-glucose-(1→2)-D-fructose

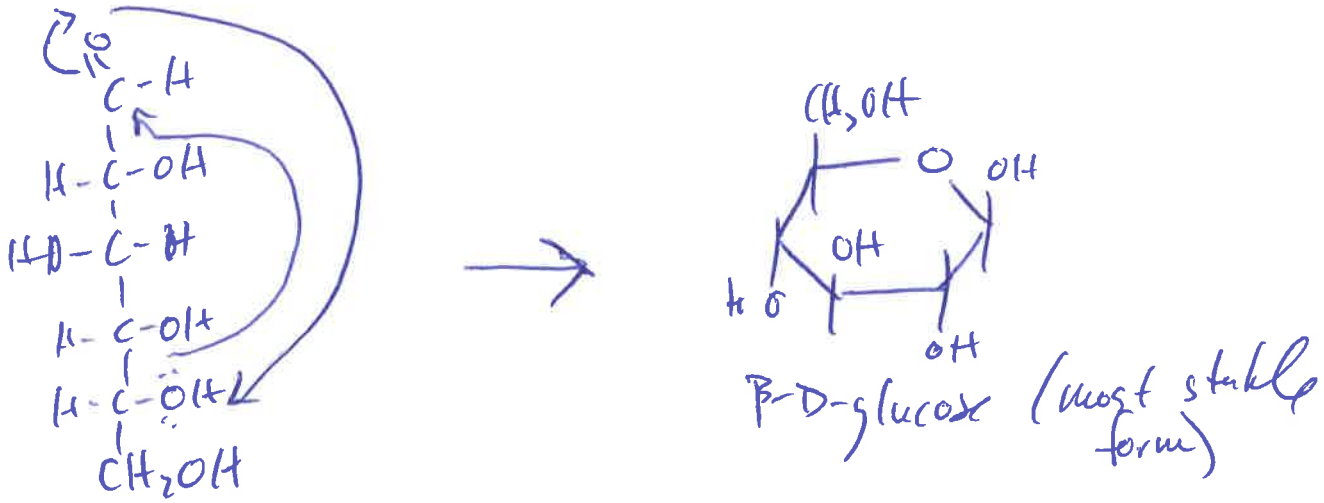
trehalose: α-D-glucose-(1→1)-α-D-glucose

lactose: β-D-galactose-(1→4)-D-glucose

cellobiose: β-D-glucose-(1→4)-β-D-glucose

Draw the picture the names say to draw!

5) (10 points) Draw the mechanism by which a linear D-glucose molecule self-converts to the hemiacetal form (From the Fisher projection to the Haworth form).

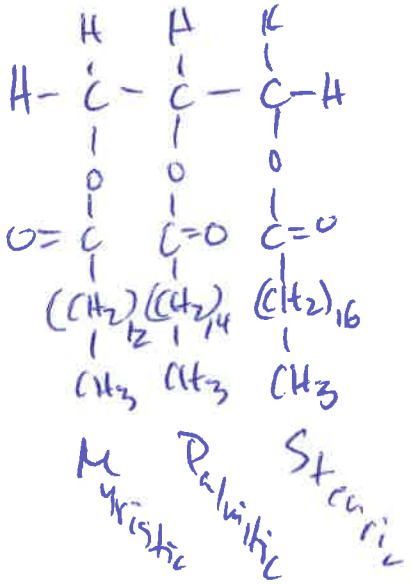


6) (5 points) Is the sugar you drew in question 3 a reducing sugar? Why or why not?

All are reducing sugars because none have a glycosidic bond on their anomeric carbon.

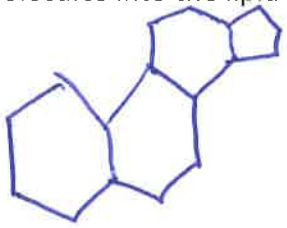
Section 3: Lipids, Membrane and Membrane Proteins

7) (5 points) Draw the structure of a triacylglycerol that has myristic acid, palmitic acid and stearic acid substituents (label each fatty acid under the chain).



Myristic acid = 14 carbons
Palmitic acid = 16 carbons
Stearic acid = 18 carbons

8) (5 points) Draw the base structure of a sterol molecule. What effect does inserting cholesterol molecules into the lipid bilayer have on the membrane?



3-six membered rings
1 5 membered ring

In low concentrations, Cholesterol can increase membrane fluidity
In high concentrations it can stiffen the membrane

9) (10 points) What do organisms do to the lipids in their cell membranes to keep them from freezing during cold weather? Why does this work?

Increase the # of unsaturated bonds in the fatty acids of the lipids in the bilayer

Why? Decreases IMF's (London Dispersion forces) thereby making the membrane more "loose"

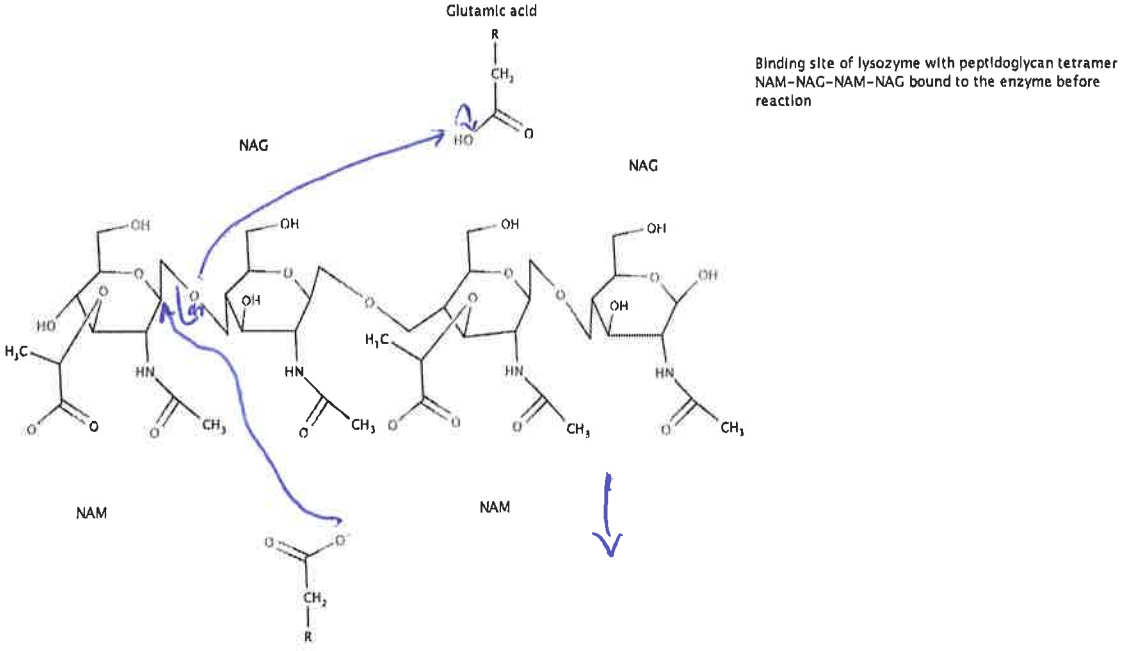
10) (10 points) What are the two types of membrane proteins? Briefly describe the chemical features of each that makes them what they are.

(1) Integral: 1) Cross the lipid bilayer
2) May be 4 or 7 α-helices or a large β-barrel
3) Hydrophobic side chains interact with membrane lipids, Polar side chains point toward each other

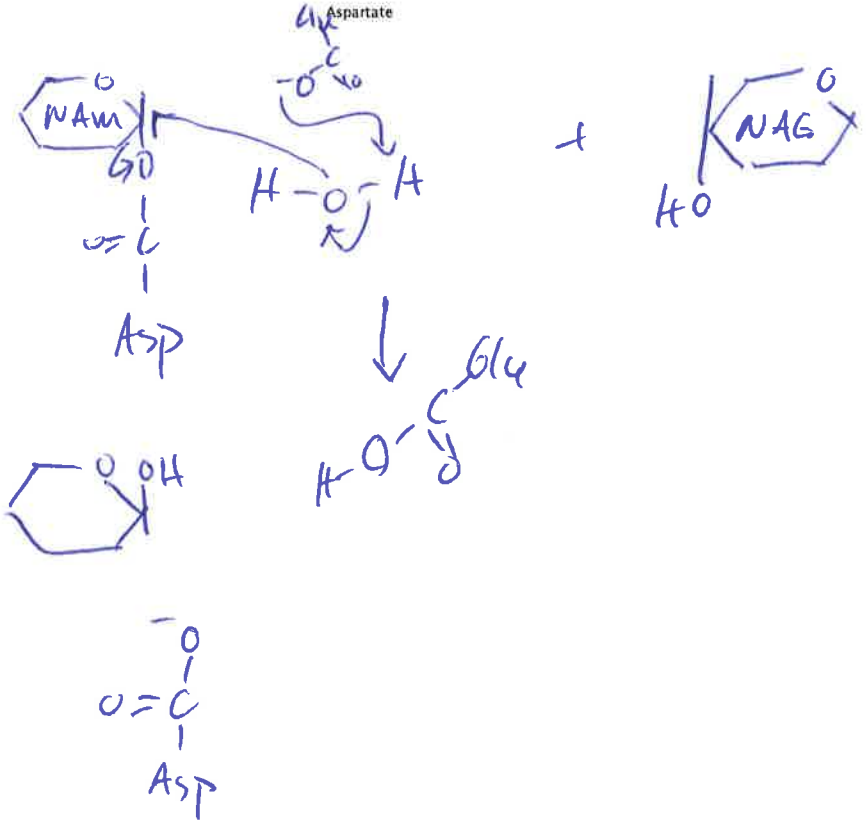
(2) Peripheral: associated loosely with the bilayer
A) May have an electrostatic interaction with the polar head group of a glycerophospholipid
b) May have a hydrophobic stretch of amino acids that inserts into the membrane to hold it in place
c) May have a fatty acid covalently attached to it to hold it in place.

Section 4: Reaction Mechanism

11) (10 points) Lysozyme is an enzyme that catalyzes the hydrolysis of the β-1,4 glycosidic bond between N-acetyl-muramic acid and N-acetyl glucosamine in the cell walls of bacteria. Given the following active site setup as a starting point, come up with a plausible mechanism that will allow the hydrolysis of the glycosidic bond between sugar monomers.

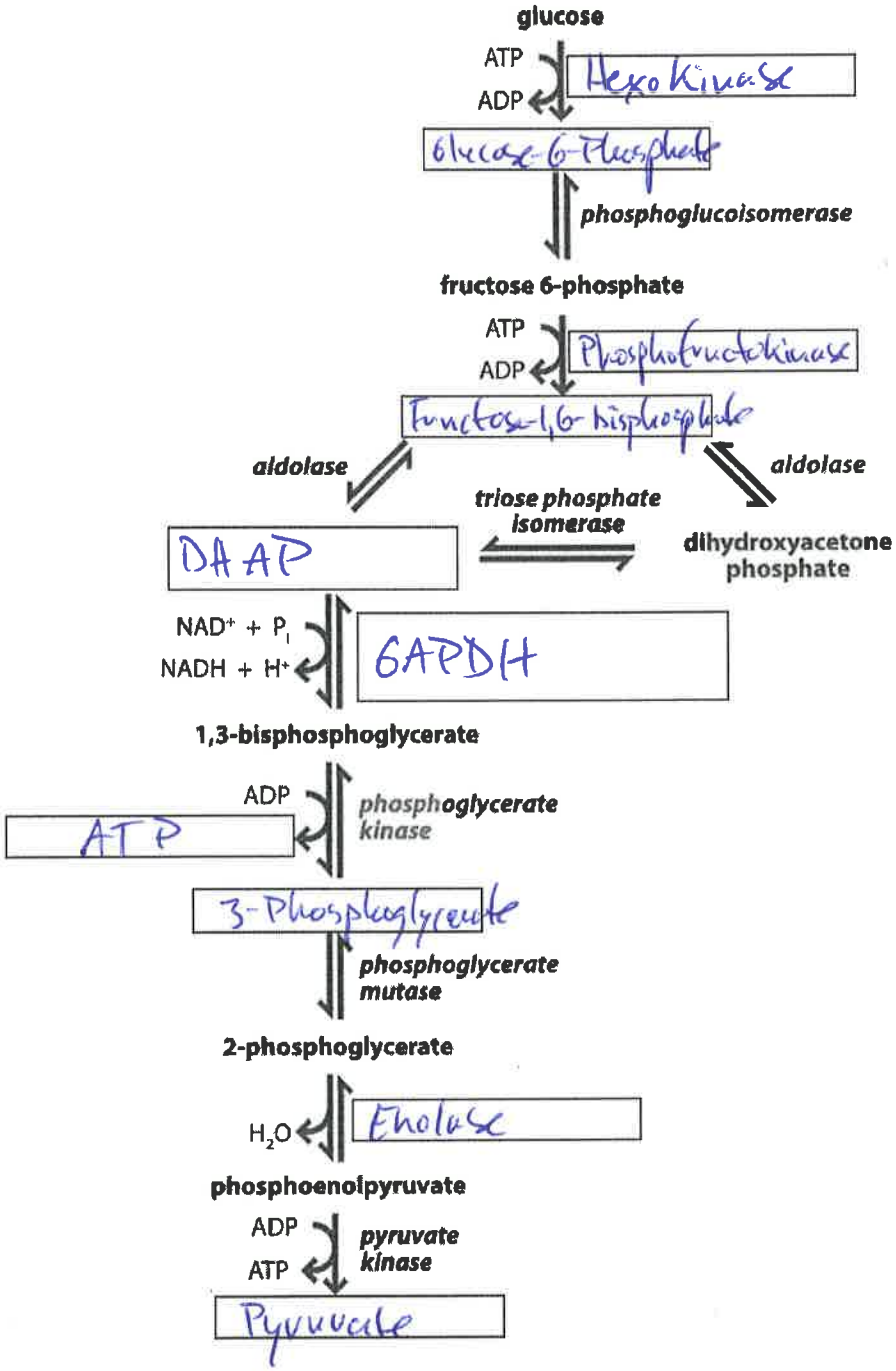


Binding site of lysozyme with peptidoglycan tetramer NAM-NAG-NAM-NAG bound to the enzyme before reaction



Section 4: Glycolysis

12) (10 points) Complete the blanks in the figure below.



13) (5 points) Why is glucose converted to fructose during glycolysis?

To make the molecule symmetrical. We want to split the 6-carbon starting molecule into two 3-carbon products

14) (5 points) What is meant by the term "coupling" in glycolysis?

Coupling can mean:

a) Tying the ΔG of hydrolysis of ATP to drive a reaction forward

b) Tying a reaction with a $+\Delta G$ value to a reaction with a $-\Delta G$ value so that the sum is a $-\Delta G$ value.

15) (5 points) How many phases are in glycolysis and what happens in each phase? (I didn't ask you how many enzymatic steps there are, I asked you how many phases there are)

2 Phases

Phase 1: Energy investment

Phase 2: Energy return.