Carbohydrates: Terminology, Conformations, and Reactions

Okay, gang: This worksheet covers what we touched on in the carbohydrate series. We're going to handle many problems reinforcing the terminology as well as the reactions surrounding carbohydrates, but I know you're up for the task.

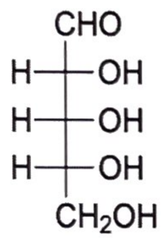
1.) In this problem, describe the monosaccharides shown in their Fischer Project form. For example, looking at the monosaccharide shown below:

a.) Designate the following:

1.) Whether it is an aldose or ketose & how many carbons are in the monosaccharide

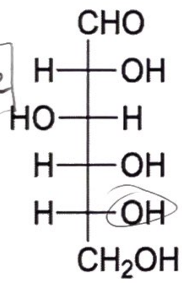
2.) Whether it is a D or L sugar

3.) Provide the name of the particular sugar, combining 1) and 2)

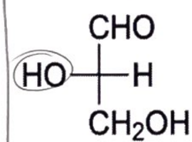


- **Aldopentose**
- **D sugar**
- **D-ribose**

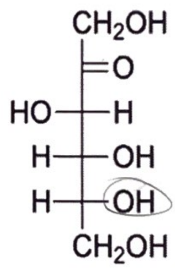
- aldohexose
- D
- D-glucose



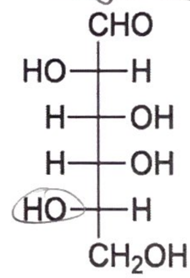
- aldotriose
- L
- L-glyceraldehyde

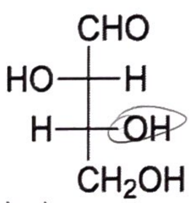


- Ketohexose
- D
- D-fructose

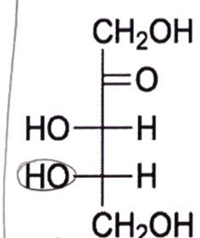


- aldohexose
- L
- L-galactose

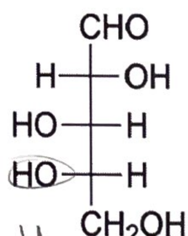




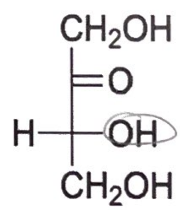
- aldotetrose
- D
- D-threose



- Ketopentose
- L
- L-ribulose



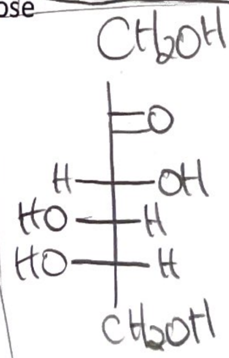
- aldopentose
- L
- L-arabinose



- Ketotetrose
- D
- D-erythulose

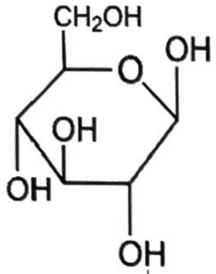
b.) *Draw & name the enantiomer of D-fructose

L-fructose →



2.) Let's keep the naming train going. Moving away from Fischer Projections, name the monosaccharides below that are shown in their closed ring, Haworth Projection, state.

a.) Make sure to include the following details (and see the example included below for reference).

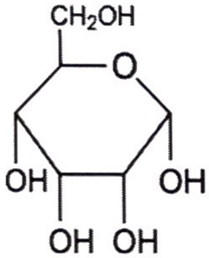


β-D-glucopyranose

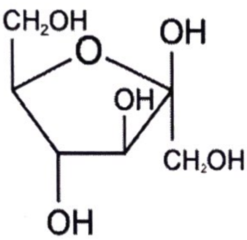
oops

β-D-glucopyranose

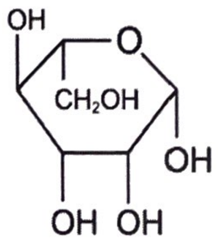
α-D-allopyranose

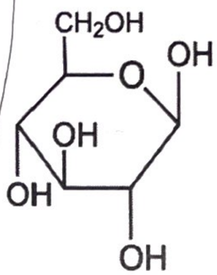


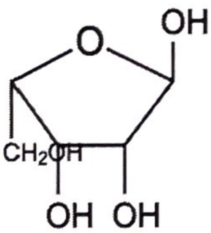
β-D-fructofuranose



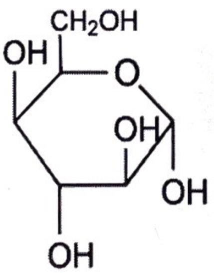
β-L-mannopyranose



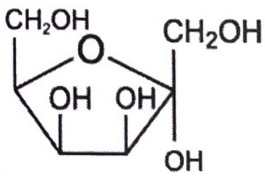




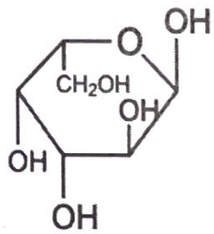
α-L-lyxofuranose



α-D-idopyranose



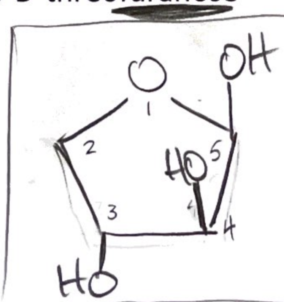
α-D-tagatofuranose



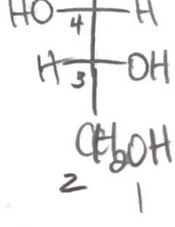
α-L-galactopyranose

5 carbon ring

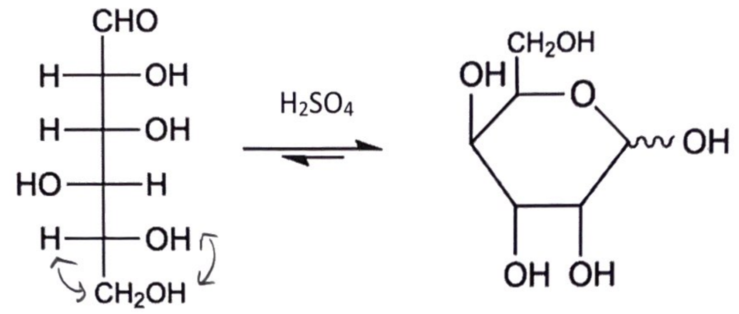
b.) Draw β-D-threofuranose



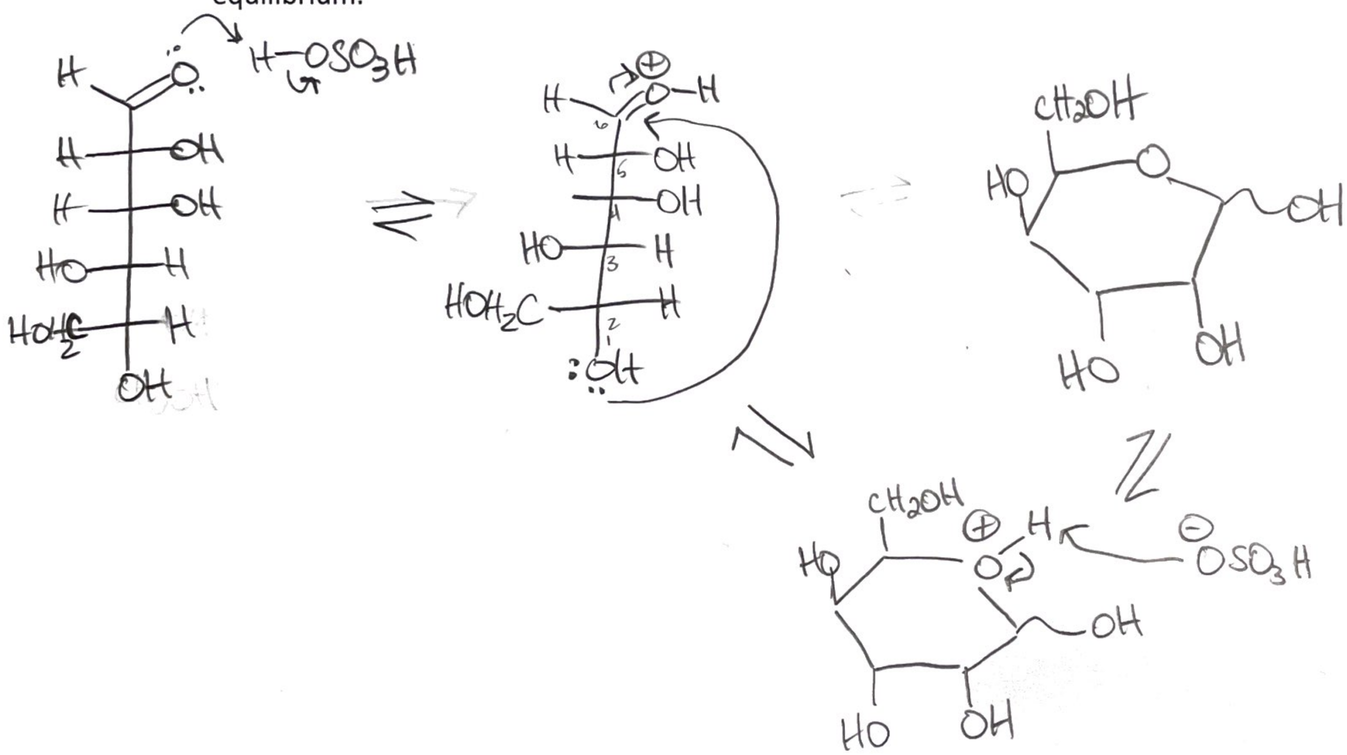
D-threose



3.) Monosaccharides in acidic environments establish an equilibrium between their straight chain form and their closed, cyclic form that heavily favors the cyclic form. An example of this phenomenon is shown below with straight chain D-gulose and D-gulopyranose



a.) Draw the mechanism for the hemiacetal formation shown and favored in the above equilibrium.



b.) Briefly explain why equilibrium favors the pyranose/furanose forms of monosaccharides over their straight chain forms. • Ring is formed (6 membered)

• Intramolecular rxn

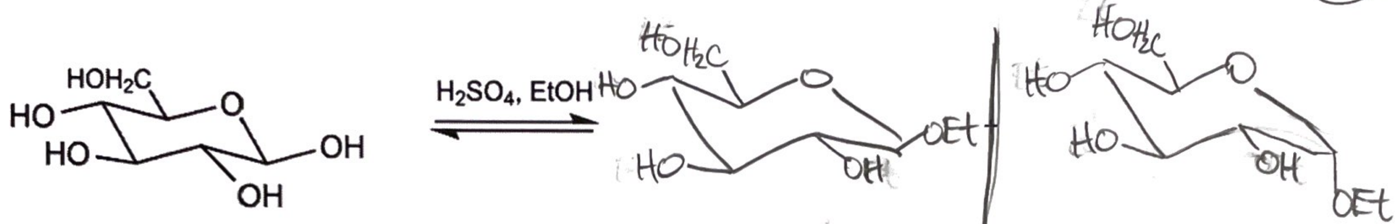
• π_{CO} is "traded" for σ_{CO}

4.) A mixture of 100% β-D-glucopyranose is subjected to the conditions below. Regarding this reaction, complete the following:

a. Predict the two glycoside products & draw a mechanism showing the formation of one of the products

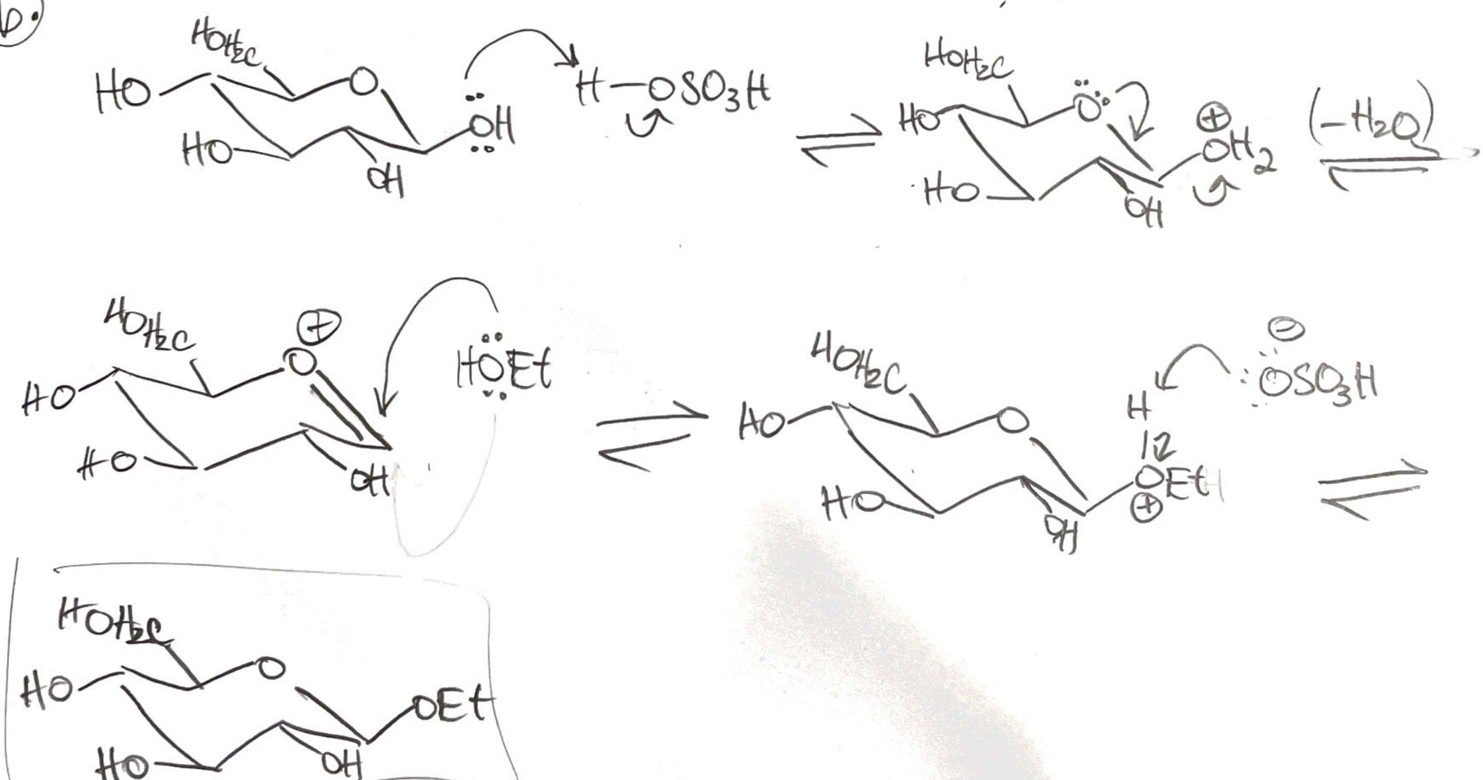
b. Name the glycosides products

(a)

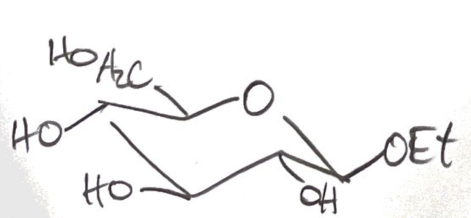


β-D-glucopyranose Glycoside 1 Glycoside 2

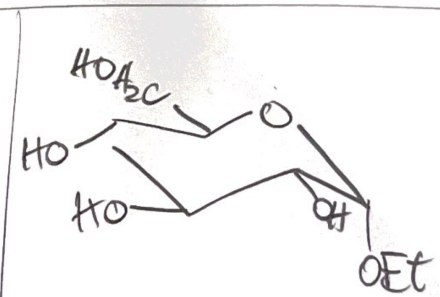
(b.)



(c.)

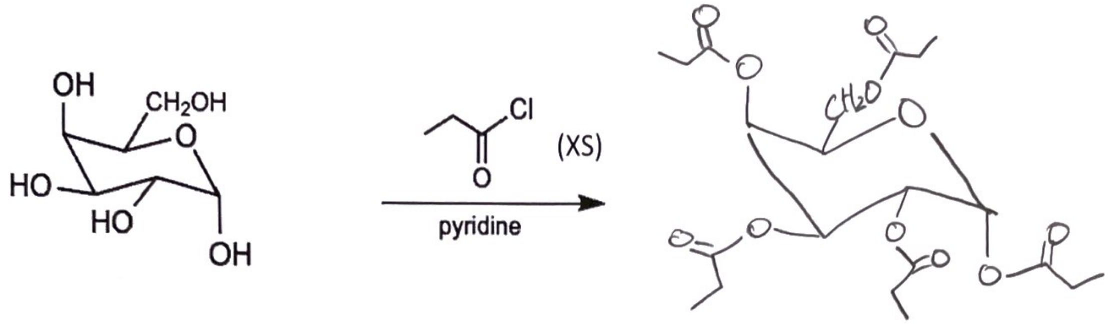


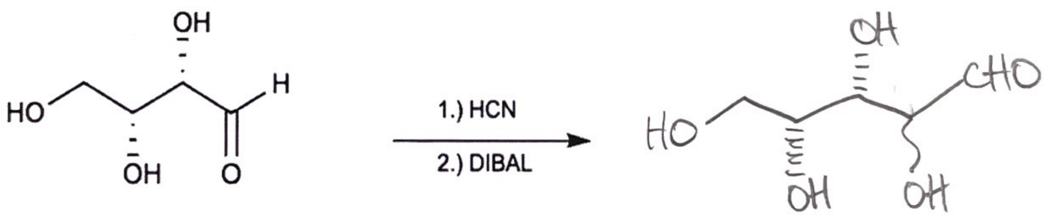
ethyl-β-D-glucopyranoside

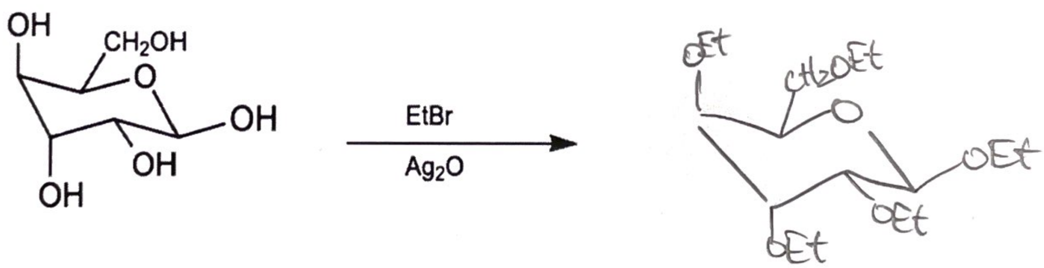


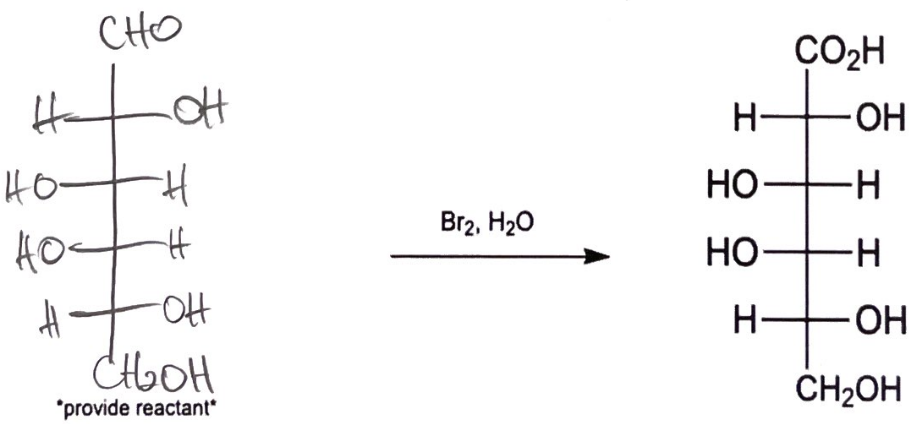
ethyl α-D-glucopyranoside

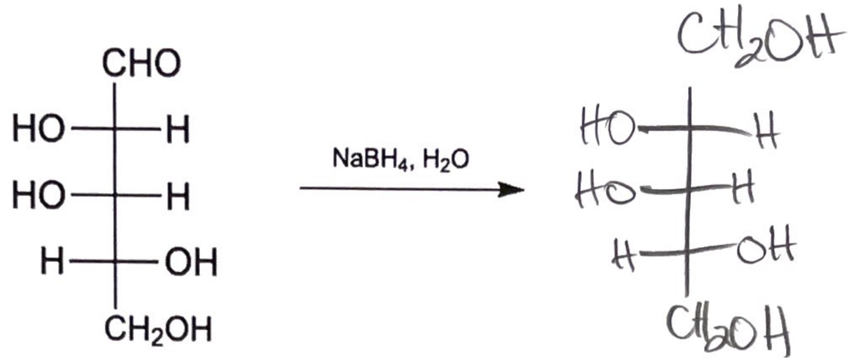
5.) For the following reactions below, either predict the major organic product, fill in the reagent, or provide the reactant. I know this is a longer worksheet, but stick with me.

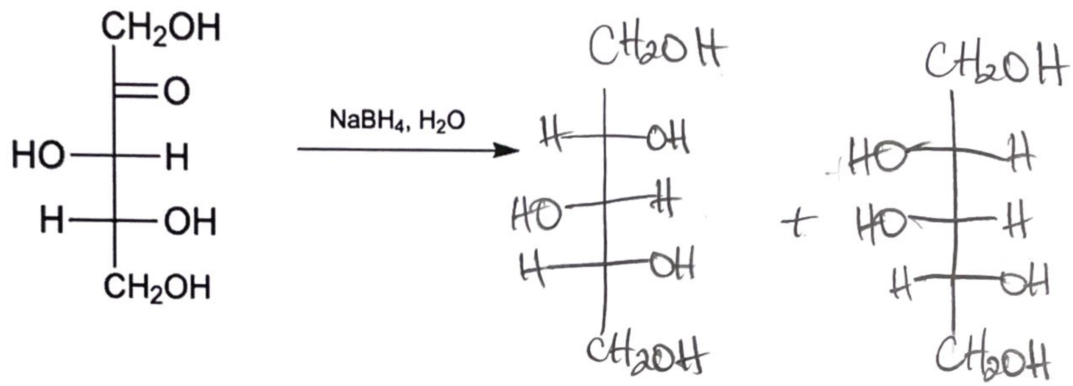






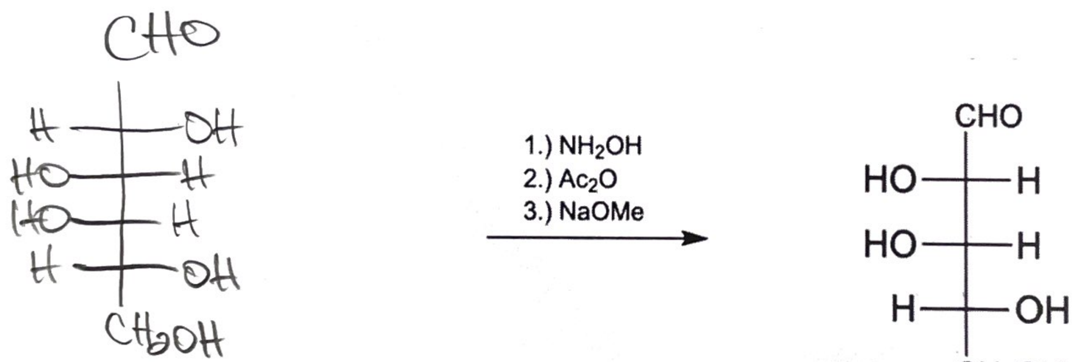






6 Carbons

(#1)



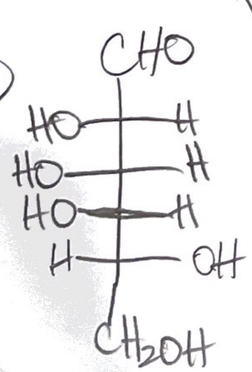
provide reactant

5 carbons

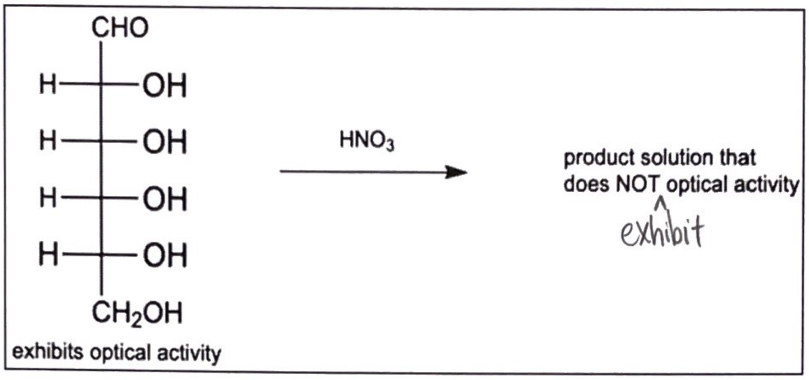
↑

2 possible answers

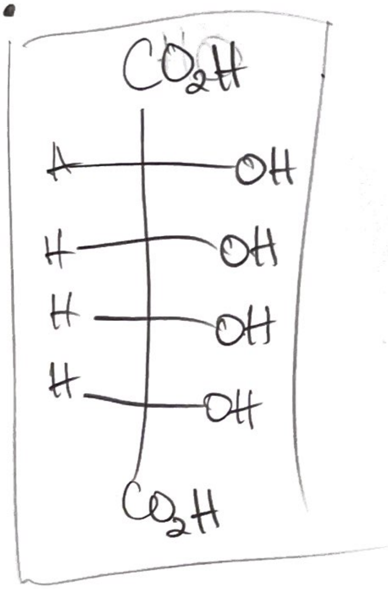
(#2)



6.) It is observed that a solution of 100% D-Allose exhibits optical activity, rotating the plane of polarized light. However, after oxidizing D-Allose with nitric acid, the resulting solution exhibits no optical activity: justify this observation (which is expected).



• HNO_3 is a more aggressive oxidation, yielding the product below:



⟹ This product has an internal plane of symmetry: the structure is meso

* the product is achiral & optically inactive

I know this worksheet has been a bear, gang, but last question—hang in there.

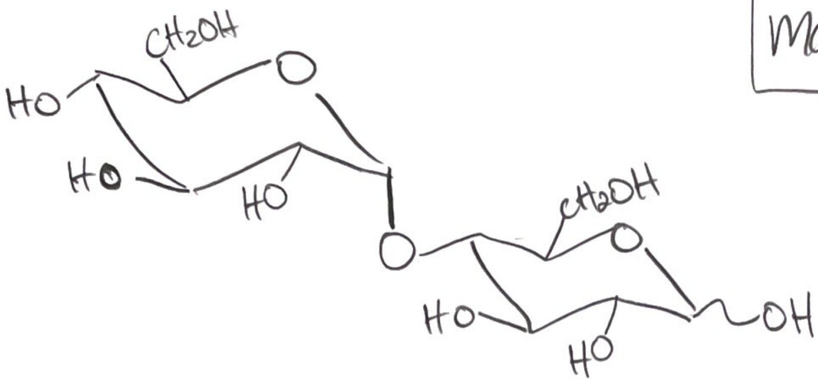
7.) For this last problem, draw two different disaccharides:

a.) One that has a 1,4 alpha glycosidic linkage

b.) One that has a 1,4 beta glycosidic linkage

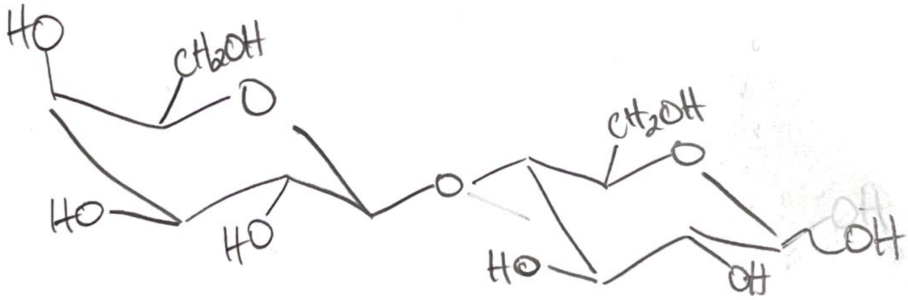
a.)

maltose



1,4-α

b.)



1,4-β

Lactose