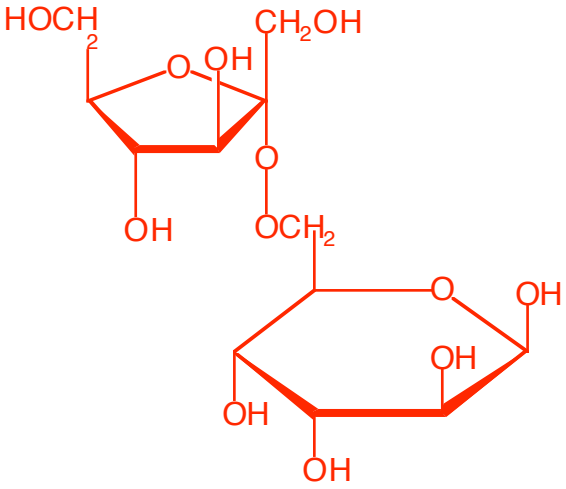
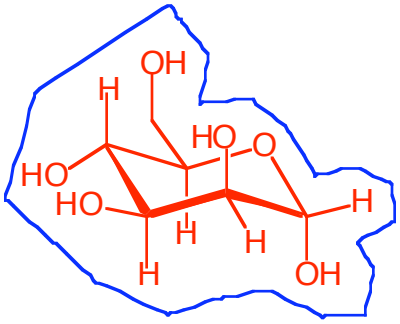
1. Illustrate the following using the appropriate type of drawing (Fischer projections, Haworth projections, etc.). Some commonly encountered sugars are provided for you on the last page of this test. Place your answers in the boxes provided.

An α-1,6'-glycoside of fructose (furanose form) and β-altrose (6 points)

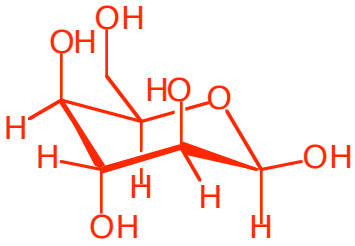


The α-pyranose of mannose & the β-pyranose of idose. *Circle the one that is more stable.* (5 points)



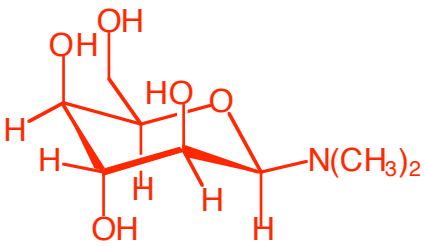
2 axial groups

vs

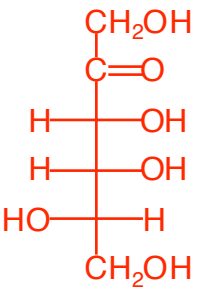


3 axial groups

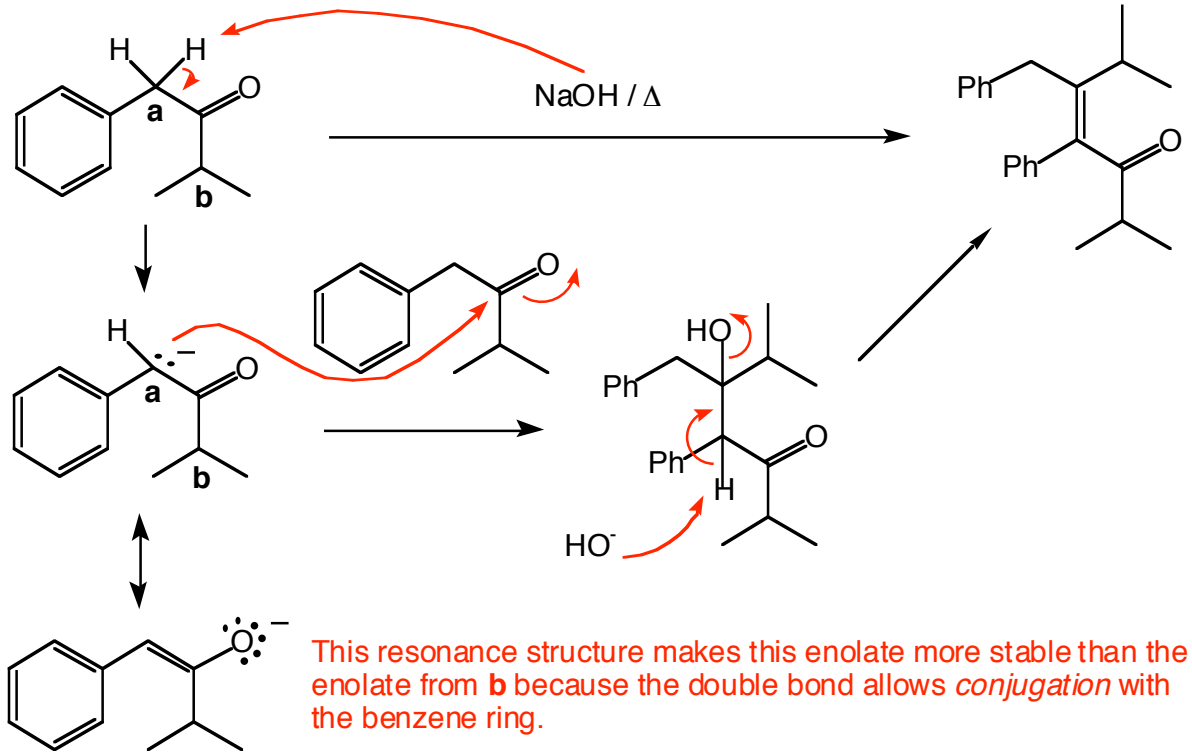
An example of an *N*-glycoside (3 points)



L-Tagatose (3 points)

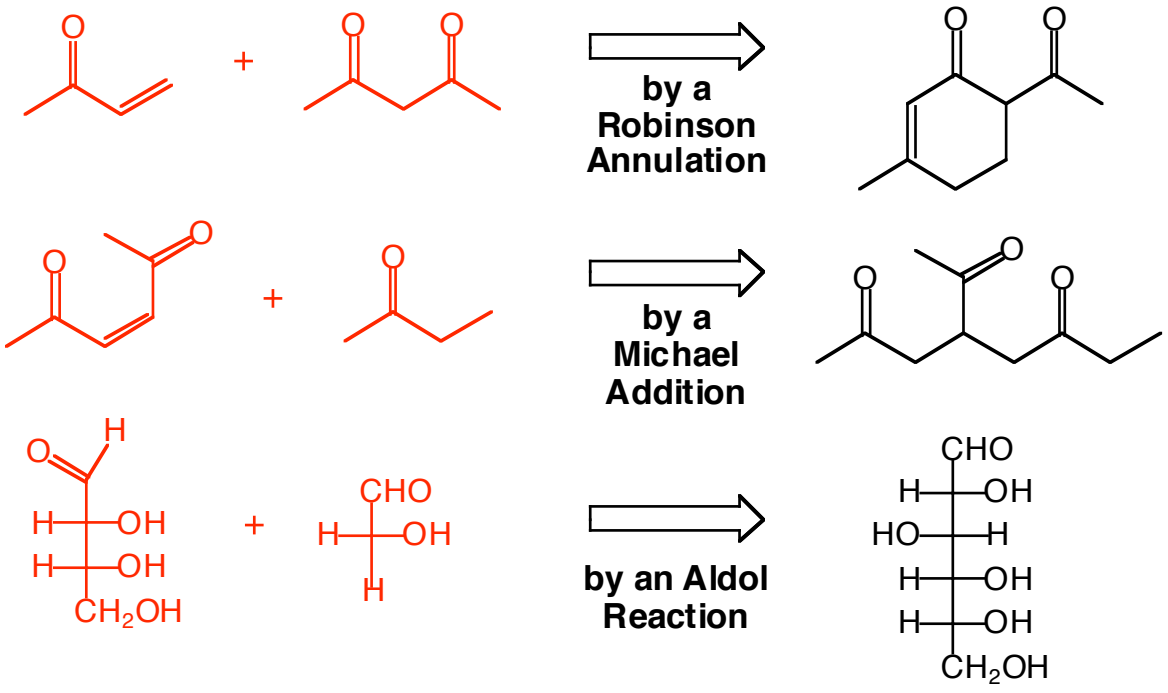


2. Provide a mechanism for the following reaction. Be sure to show all charges, intermediates, and lone pairs of electrons in your structures. Then briefly explain why the enolate is formed preferentially at carbon **a** rather than at carbon **b**. (10 points)



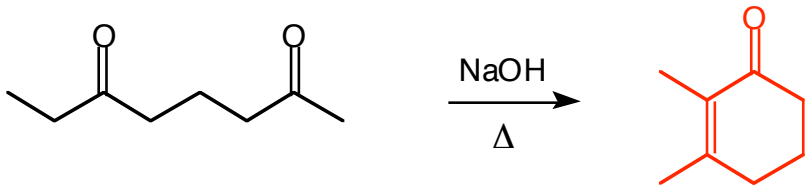
This resonance structure makes this enolate more stable than the enolate from **b** because the double bond allows *conjugation* with the benzene ring.

3. Provide the most logical starting material(s) for the products below. (15 points)

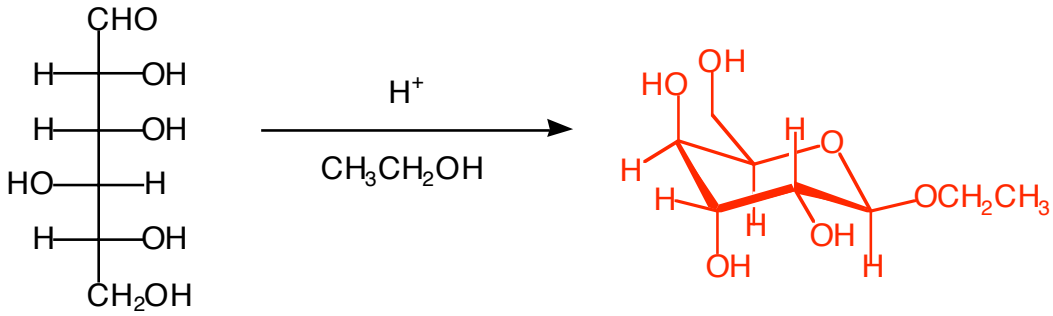


4. Predict the product(s) of the following reactions. *Circle* the *major product* in each case. (30 points)

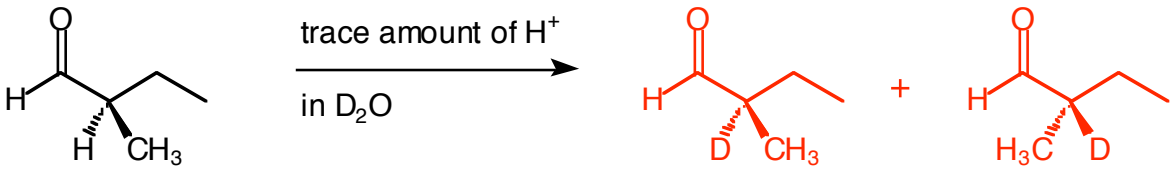
a)



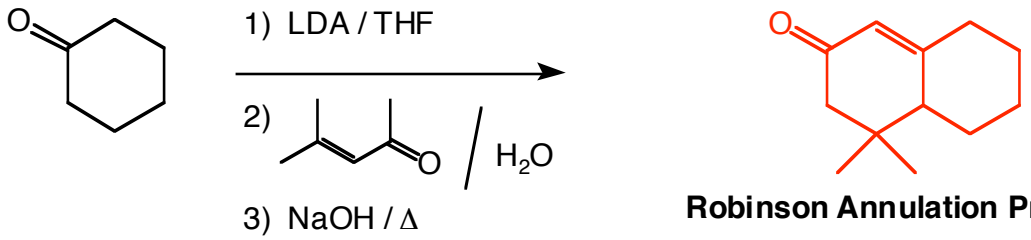
b)



c)

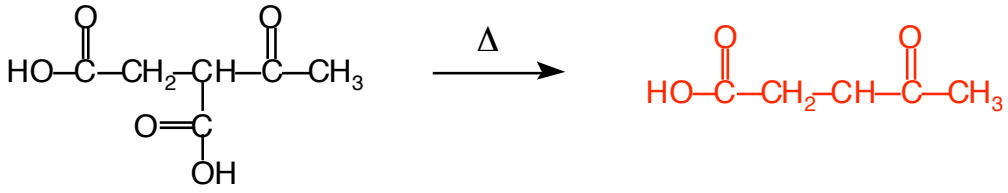


d)

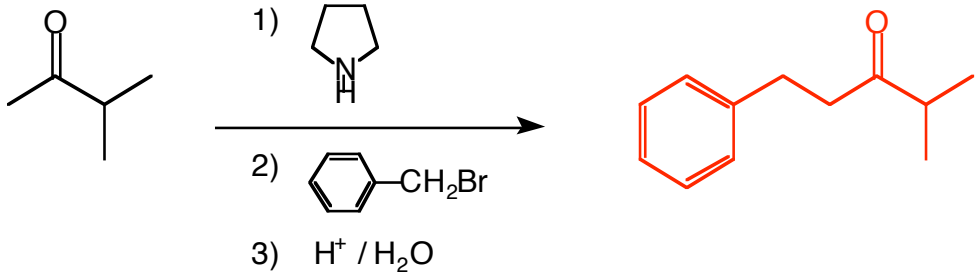


Robinson Annulation Product

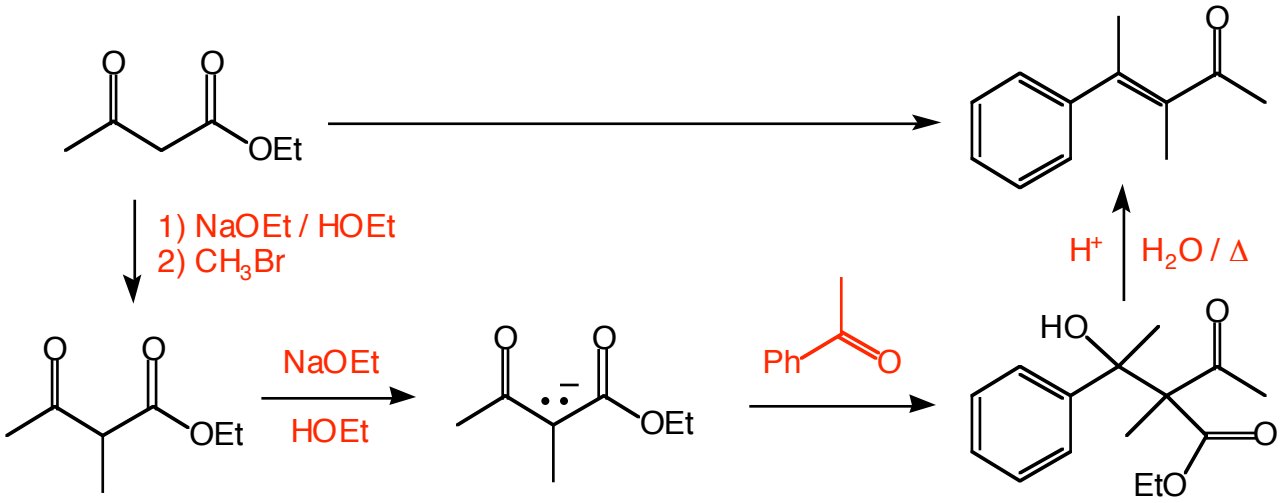
e)



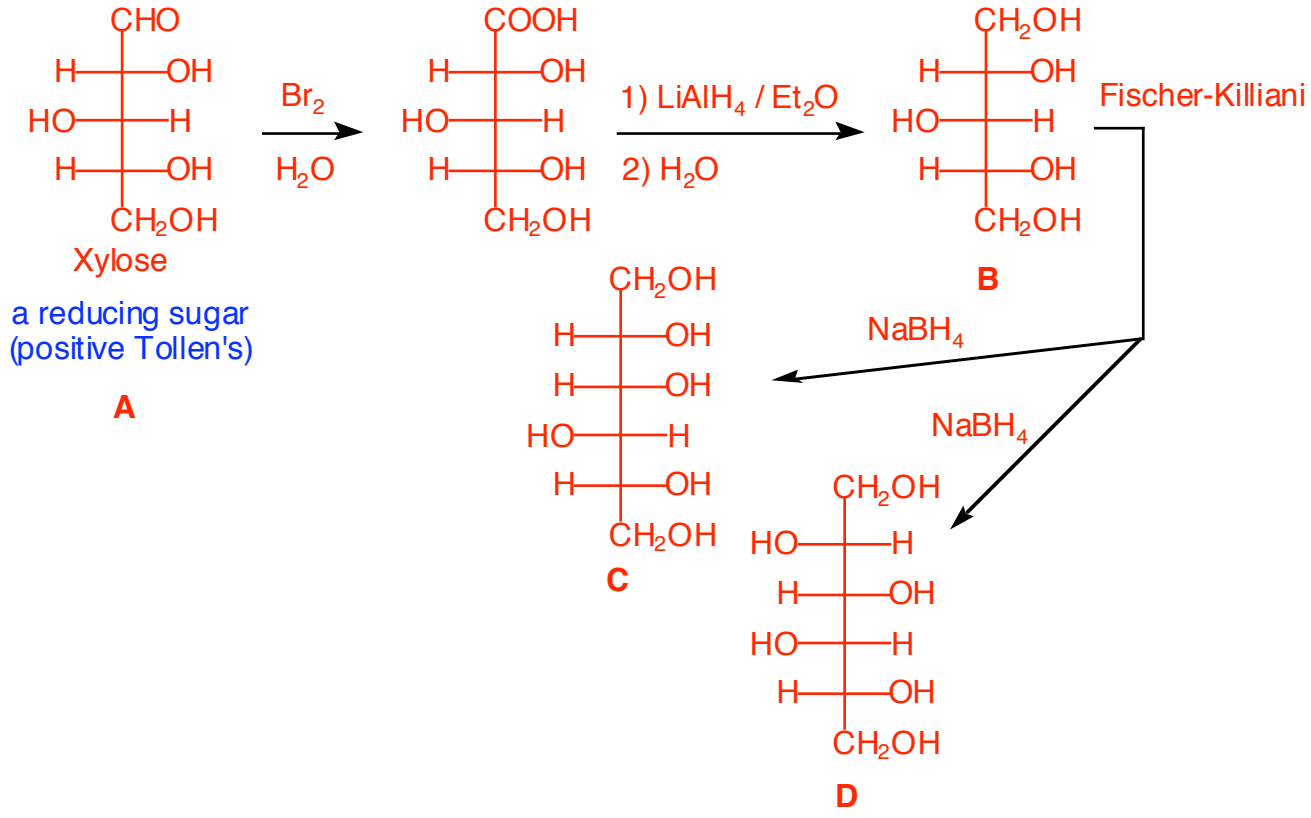
f)



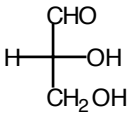
5. Provide a synthesis for the following transformation. For full credit, be sure to draw all intermediary products along the way. (12 points)

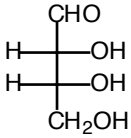


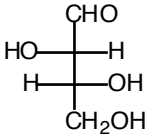
6. The label has fallen off a bottle that contains a sugar, **A**, with the formula $C_5H_{10}O_5$. This sugar gives a positive Tollens test. Reaction of **A** with Br_2 / H_2O followed by reaction with $LiAlH_4$ in Et_2O and workup with H_2O gives **B**, an optically inactive sugar. Fischer-Killiani chain elongation of **A** followed by $NaBH_4$ reduction gives two products, **C** and **D**, both of which are optically active. Provide clearly labeled structures for **A**-**D** below. Show your work or reasoning. (16 points)

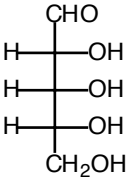


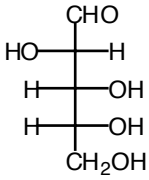
The D-Series of Aldoses

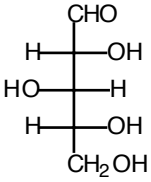

Glyceraldehyde

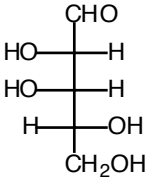

Erythrose

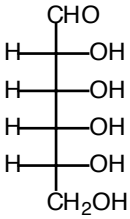

Threose

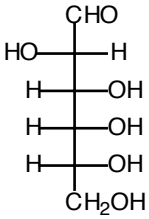

Ribose

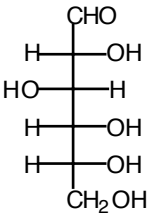

Arabinose

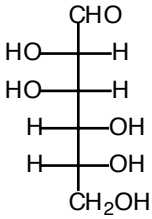

Xylose

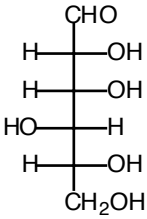

Lyxose

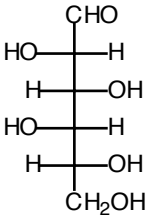

Allose

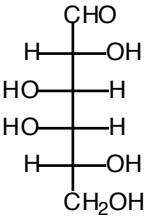

Altrose

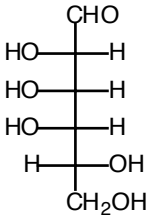

Glucose


Mannose

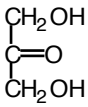

Gulose

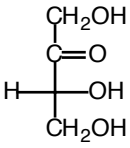

Idose

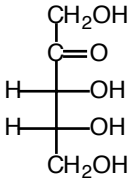

Galactose

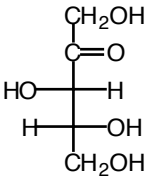

Talose

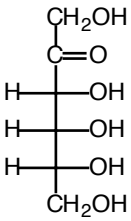
The D-Series of Ketoses

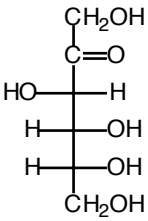

Dihydroxyacetone

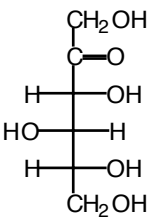

Erythrulose

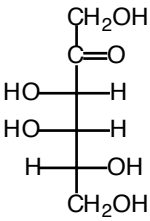

Ribulose


Xylulose


Psicose


Fructose


Sorbose


Tagatose