(a) ![structure](image1)

(b) ![structure](image2)

(c) ![structure](image3)

(d) ![structure](image4)

(e) ![structure](image5)

(f) ![structure](image6)

Guidance on (b) - from the $pK_a$ table

Getting to $\alpha$-D-allofuranose needs a glucofuranose as a reference; you can use three of the $pK_a$ table structures to create $\beta$-D-glucofuranose.

1. Make the $\beta$-D-glucofuranose from the $pK_a$ table information,

2. Then make the $\alpha$ C-3 epimer of $\beta$-D-glucofuranose.
On deciding about the order of the two mechanistic steps:

The mild base concentration must be quite low by definition, and leads to the idea that the dimethylsulfate should be reacting with the alcohol in the first step and not getting deprotonated.

Why? Well, one good argument would be that if there was enough base strength to be deprotonating the alcohols, that hydroxide should be in high enough concentration to also be reacting with the dimethylsulfide. Why would the oxygen anion of the hydroxide not be competing with the bulkier oxygen anion you would form by deprotonating the alcohol?
indican
2-butanol

3-buten-2-ol

(R)-2-hydroxypropanoic acid
16.18

(a)

(b) 1) \(\text{O} / \text{TsOH}\)  
     2) NaBH\(_4\) / CH\(_3\)OH

\[
\begin{align*}
\text{(a)} & & \text{(b)} \\
\text{S} & & \text{S} \\
\text{Ph} & & \text{Ph} \\
\text{O} & & \text{O} \\
\text{O} & & \text{O} \\
\text{Ph} & & \text{Ph} \\
\text{OCH}_3 & & \text{OCH}_3 \\
\end{align*}
\]

\[
\begin{align*}
\text{HO} & & \text{HO} \\
\text{O} & & \text{O} \\
\text{Ph} & & \text{Ph} \\
\text{OH} & & \text{Ph} \\
\text{OTs} & & \text{OTs} \\
\end{align*}
\]
reaction of the ketals and hemiacetals is expected to be faster than the ester, so conditions where it does not hydrolyze are quite possible to find.
the gauche-gauche form places nbe pairs on the oxygen atoms in a position that is anti to the adjacent CO sigma bond, and according to the anomeric effect, the nbe pair can be delocalized (hyperconjugation) by the CO antibonding sigma orbital.

In the anti-anti form, the CH$_3$O bonds are anti to the adjacent CO sigma bonds, and no nbe delocalization is possible with the CO antibonding orbital.