1. Please draw the alkene that when hydrogenated affords compound 1. Place your answer in the box and indicate proper stereochemistry when necessary. 5pts.

2. Please draw the mechanism for the following transformation showing the necessary stereochemistry (indicate which face of the alkene is attacked). 7 pts.

Note: Attacking wrong oxygen 1/7
3. Please draw the major product(s) for the following reactions. Show proper stereochemistry where necessary. 3 pt EACH box.

3/3 a) 
\[
\begin{align*}
\text{Cyclohexene} & \xrightarrow{\text{Pd/C}} \text{D} \\
\text{D} & \xrightarrow{\text{D}_2} \text{syn addition of D}_2 \\
\end{align*}
\]

if no stereochemistry
then 1/3 if addition
is otherwise correct.

3/3 b) 
\[
\begin{align*}
\text{Cyclohexene} & \xrightarrow{\text{RhCl(Ph₃P)₃}} \text{H}_2 (\text{Excess}) \\
\end{align*}
\]

b) 

6/6 c) 
\[
\begin{align*}
\text{Cyclohexene} & \xrightarrow{\text{Cl}_2} \text{CCl}_4 \\
\end{align*}
\]

These two products are stereoisomers

6/6 d) 
\[
\begin{align*}
\text{Cyclohexene} & \xrightarrow{\text{Br}_2} \text{CH}_3\text{OH} \\
\end{align*}
\]

These two products are stereoisomers

3/3 e) 
\[
\begin{align*}
\text{But-2-ene} & \xrightarrow{\text{1. Hg(OAc)}_2, \text{H}_2\text{O}} \text{OH} \\
\text{But-2-ene} & \xrightarrow{\text{2. NaBH}_4, \text{H}_2\text{O}} \text{OH} \\
\end{align*}
\]

Continued on page 3...
continued on page 4....
4. Please provide the mechanism for the following transformation. 5pts.
5. The following reaction provides **FOUR** stereoisomers. Please draw them and place boxes around your final answers. 4 pts each for a total of **16** pts.

![Chemical structures](image)

6. Draw the alkyne starting material that affords ketone **2** in the following reaction. Use the box provided. **5** pts.

![Chemical structures](image)
7. Provide a synthesis for compound 4 starting from compound 3. No mechanisms necessary. Hint: you may have to provide appropriate solvent(s) to ensure a desired stereochemical outcome. 5 pts.

Note: H₂O in step 3 may be omitted for credit.

b) Step 5 involves SN2 on a sp²-center, This is ok if proper solvent is used.

Partial credit for any synthesis similar to one shown.