1. Predict the major product(s) of these reactions. Be sure to show stereochemistry explicitly, if applicable. (24 pts)

a. 

\[
\text{1. BH}_3\text{-THF} \\
\text{2. H}_2\text{O}_2, \text{HO}^-
\]

b. 

\[
\text{excess HBr}
\]

c. 

\[
\text{Br}_2, \text{H}_2\text{O}
\]

d. 

\[
\text{cold K}_2\text{MnO}_4 \\
\text{HO}^-, \text{H}_2\text{O}
\]

e. 

\[
\text{C}_6\text{H}_5\text{CO}_3\text{H}
\]

f. 

\[
\text{H}_2, \text{Pd}
\]

2. Propose a mechanism for this reaction. Be sure to show each step and intermediate explicitly if applicable, and show all necessary mechanistic arrows. (5 pts)

\[
\text{H}_3\text{O}^+, \text{H}_2\text{O}
\]
3. Draw the 3 most important resonance forms for the **bromonium ion intermediate** formed here. Circle the most important structure, and indicate what makes it most important. (5 pts)

4. Complete this reaction sequence. (8 pts)

5. Propose syntheses, being sure to indicate all reagents required. (8 pts)
   
a.

   b. 2 CH₃CH=O from CH₃CH₂C≡CH
1. Give the structure of the major organic product or products expected from the following reactions. Show the stereochemistry of the products if applicable. No reaction may be an appropriate answer in some cases. (5 points each)

a)

b)

1. NaNH₂, excess, heat
2. H₂O
BH₃:THF
H₂O₂, NaOH

NaOC₂H₅
C₂H₅OH
Br₂
H₂O

O₃
Zn, water

d) HgSO₄
H₂SO₄, water

e) Cold dilute
KMnO₄
2. Propose an efficient synthesis of each of the following compounds from the given starting material and any needed reagents or solvents (10 points each):

a) ![Chemical Structure]

b) ![Chemical Structure]

3. Propose a reasonable mechanism for the following reaction (5 points):

![Chemical Reaction]
1. (4 points) Circle the stereospecificity of these reactions. Hint: this might help you for Question 2.

A. Na with liq. NH₃
   Syn  Anti  Does not matter

B. cold KMnO₄ with dil. –OH
   Syn  Anti  Does not matter

C. H₂ with Pd, Pt, or Ni
   Syn  Anti  Does not matter

D. 1. RCO₂H; 2. H₃O⁺/H₂O
   Syn  Anti  Does not matter

2. (26 points) Predict the major organic product(s) of these reactions. If there are two products, write both products. **Indicate stereochemistry as required with wedges and dashes.**
3. Propose syntheses of the desired products from the starting materials indicated, using any other reagents necessary. It will be very helpful if you count your carbons first.

a. (6 points)

\[
\begin{align*}
\text{starting material} & \quad \rightarrow \\
\text{product} & \quad \downarrow
\end{align*}
\]

b. (6 points)

\[
\begin{align*}
\text{starting material} & \quad \rightarrow \\
\text{product} & \quad \downarrow
\end{align*}
\]

4. (8 points) Propose a mechanism for this halohydrin formation. Be sure to show each step, intermediates (especially the bromonium ion), and show all necessary mechanistic arrows. Pay close attention to the regioselectivity on this mechanism.

\[
\begin{align*}
\text{starting material} & \quad \rightarrow \\
\text{product} & \quad \downarrow
\end{align*}
\]
1. Predict the major organic product or products obtained in each of the following reactions - (16 pts.)

a) \[
\text{Cyclopentene} \xrightarrow{\text{Cold KMnO}_4, \text{NaOH}} \]

b) \[
\text{Propyne} \xrightarrow{\text{H}_2, \text{Lindlar's catalyst}} \]

c) \[
\text{Cyclopentene} \xrightarrow{\text{H}_2, \text{Pt}} \]

d) \[
\text{Propyne} \xrightarrow{1) \text{O}_3, 2) \text{H}_2\text{O}} \]

2. Write the structure of the starting material in the following reaction (4 pts)

\[
\text{Propyne} \xrightarrow{1) \text{O}_3, 2) \text{Zn/HCl}} \text{Butyric acid} + \text{Acetaldehyde} \]

3. Propose a synthesis of each of these compounds, from the given starting material and any other reagent and/or solvent. (18 pts.)

a) \[
\text{Diacetyl} \]

from \[
\text{Cyclopentyl bromide} \]
4. Propose a mechanism for the following reaction- (4 pts.)

5. Write the structures of the products formed in the following sequence of reaction (8 pts)