1. (15 pts)

a) Select the correct name for the following molecules.

- a) 3,5-dimethylhepta-2Z,4E-diene
- b) 3,5-dimethylhepta-2E,4Z-diene
- c) 3,5-dimethylhepta-2Z,4Z-diene
- d) 3,5-dimethylhepta-2E,4E-diene

b) Identify each molecule drawn below as having either an E or Z stereochemical designation. Circle your answer.

2. (22 pts)

a) The ratio of the rate constants is 1 \( (k_f/k_D = 1) \) for the dehydrohalogenation reaction shown below. What is the significance of that ratio in this context? Does the ratio support an E-1 or E-2 pathway? Explain completely.

- If \( k_f/k_D = 1 \) it means the rate doesn't change when H is changed to D. That means the loss of H does not occur in rate step - therefore E-1.

b) Use the framework provided to draw the Newman projection for the starting material in the E-2 reaction shown below. Draw the Newman projection that will allow you to select the identity of the product that will form. Which product is formed?

- Saytzeff
- Hoffman

- NaOCH₃
- KOC(CH₃)₃

Saytzeff is favored under normal conditions if the base is hindered however the external H is more accessible.
d) Draw cis-1-bromo-2-phenylcyclohexane on the chair-skeleton, and use this drawing as part of your explanation to predict which of the two alkenes will be formed as the major product in this example of an E-2 reaction.

```
\begin{align*}
&\text{cis-1-bromo-2-phenylcyclohexane} \\
&\quad \rightarrow \text{KOH} \\
&\quad \rightarrow \text{major product} \\
&\quad \text{or} \\
&\quad \text{minor product}
\end{align*}
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Sayzeff is favored.

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e) Outline the mechanism for the acid-catalyzed isomerization of the double bond in the following molecule. Show the motion of all electron movement with arrows and supply the structure of the intermediate in the supplied box. In what direction does the equilibrium lean, the left or right?

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\begin{align*}
\text{dilute HCl} & \quad \rightarrow \quad \text{intermediate} \\
& \quad \rightarrow \quad \text{H}_2\text{O}^+ \quad [\text{Cl}^-]
\end{align*}
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3. (39 pts)

a) In the spirit of 217 where you will be asked to do synthesis, complete the following synthetic sequence by supplying structures and or reagents as is required.

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\begin{align*}
&\text{NBS} \\
&\quad \rightarrow \quad ? \\
&\text{KOH} \\
&\quad \rightarrow \quad ? \\
&\text{Br}_2/\text{H}_2\text{O} \\
&\quad \rightarrow \quad ? \\
\end{align*}
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b) Identify the structure of the major products that are formed in each of the following reactions and indicate the stereochemistry where it is important. For reactions where a mixture of enantiomers can form, showing a single enantiomer is permissible.

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\begin{align*}
&\text{Grubb's} \quad (\text{Cy}_3\text{P})_2\text{Cl}_2\text{Ru}=\text{CHPh} \\
&\quad \rightarrow \quad ? \\
&1) \text{O}_3 \\
&2) \text{Zn}/\text{HOAc} \text{ or} \\
&2) \text{DMS} \\
&\text{Br}_2/\text{Kl} \\
&\quad \rightarrow \quad ? \\
&\text{H}_2/\text{Pd} \\
&\quad \rightarrow \quad ? \\
&\text{Br}_2 \\
&\quad \rightarrow \quad ? \\
&\text{OsO}_4/\text{H}_2\text{O}_2 \\
&\quad \rightarrow \quad ? \\
&1) \text{BH}_3 \\
&2) \text{H}_2\text{O}_2, \text{OH}^- \\
&\text{HBr/ROOR} \\
&\quad \rightarrow \quad ? \\
&1) \text{Hg(OAc)}_2/\text{H}_2\text{O} \\
&2) \text{NaBH}_4
\end{align*}
```
c) Under standard reaction conditions mixtures of enantiomers are formed when planar (flat) molecules react. From the alkene isomers (E or Z) drawn below, identify which set of enantiomers will form under bromohydrin conditions (Br₂/H₂O). For each alkene circle an arrow to show the direction of its reaction.

Bromonium opens up water → trans-pod

![Diagram showing enantiomers]

d) Supply the required reagents for the following oxidation reactions.

![Diagram showing oxidation reactions]

e) Which isomer (I or II) will be formed in the reaction shown below (Br₂/KI), based upon the results of direct epoxidation (mCPBA)?

If bromonium forms on top face it

![Diagram showing isomer formation]

4. (9 pts) An unknown molecule of formula C₈H₁₀ reacts with an excess of hydrogen [H₂ / Pd] to produce a molecule of formula C₈H₁₄. When the C₈H₁₀ molecule reacts under conditions of ozonolysis [1) O₃, 2) DMS] two products are produced. They are shown below. The only IR peaks of interest for the C₈H₁₀ molecule are located at 3066 and 1664 cm⁻¹. There are 8 signals (151.1, 136.5, 134.3, 103.3, 51.1, 50.2, 42.2 and 33.68) in the CNMR for the C₈H₁₀ molecule. In its DEPT 90 there are four signals (136.5, 134.3, 51.1 and 50.28) and in the DEPT 135 there are seven signals (136.5, 134.3, 103.3, 51.1, 50.2, 42.2, and 33.68) with three of the peaks being negative (103.3, 42.2, and 33.68). Calculate units of unsaturation and then explain your logic in tying together the hydrogenation and ozonolysis information to produce a structure. Finally explain how your DEPT information confirms your structure.