Which best describes the product(s) of the following reaction?

**Syn-addition of H₂ across the C=C bond forms the cis-isomer**
Question 2

For which of the following isomers is the following reaction MOST exothermic?

\[ \text{C}_8\text{H}_{16} + \text{H}_2 \rightarrow \text{C}_8\text{H}_{18} \]

A  2,3-dimethyl-(3E)-hexene    C  2,3-dimethyl-2-hexene
B  4,5-dimethyl-(2E)-hexene    D  4,5-dimethyl-1-hexene

Among these isomeric alkenes, the least substituted alkene will be the highest energy isomer, since D has only ONE substituent on the C=C bond, it is a MONOsubstituted alkene, it is highest in energy, it thus starts higher in energy, its reaction is thus most exothermic.
**Question 3**

**MCalkenesIn**

Which are the best reagents/conditions for the following reaction?

\[
\begin{align*}
A & \quad \text{H}_2\text{O}/\text{H}_2\text{SO}_4 \quad \text{(cat.)} \\
B & \quad 1. \text{BH}_3.\text{THF} \\
& \quad 2. \text{NaOH}/\text{H}_2\text{O}_2 \\
C & \quad \text{conc. H}_2\text{SO}_4/\text{heat} \\
D & \quad 1. \text{Hg(OAc)}_2/\text{H}_2\text{O} \\
& \quad 2. \text{NaBH}_4
\end{align*}
\]

Markovnikov-like addition of H\textsubscript{2}O across the C=C bond WITH rearrangement, requires a carbocation intermediate and this a BRONSTED acid catalyst.
Only one of the following reactions actually gives the correct product, the other reactions actually give different products. Identify the correct reaction. (ignore stereochemistry in this problem)

A  4-ethyl-3-heptene  \( \xrightarrow{1. \text{BH}_3\cdot\text{THF}} \) \( \xrightarrow{2. \text{NaOH}/\text{H}_2\text{O}_2} \) \( \xrightarrow{\text{product}} \)

B  2-ethyl-2-heptene  \( \xrightarrow{1. \text{H}_2\text{O}/\text{Hg(OAc)}_2} \) \( \xrightarrow{2. \text{NaBH}_4} \) \( \xrightarrow{\text{product}} \)

C  3-ethyl-3-heptene  \( \xrightarrow{1. \text{BH}_3\cdot\text{THF}} \) \( \xrightarrow{2. \text{NaOH}/\text{H}_2\text{O}_2} \) \( \xrightarrow{\text{product}} \)

D  3-ethyl-3-heptene  \( \xrightarrow{1. \text{H}_2\text{O}/\text{Hg(OAc)}_2} \) \( \xrightarrow{2. \text{NaBH}_4} \) \( \xrightarrow{\text{product}} \)
Question 5
MCalkenesIu

Give the best reagents/conditions to perform the following reaction

A  H$_2$O/H$_2$SO$_4$ (cat.)
B  1. BH$_3$.THF
    2. NaOH/H$_2$O$_2$
C  conc. H$_2$SO$_4$/heat
D  1. Hg(OAc)$_2$/H$_2$O
    2. NaBH$_4$

I DON'T ALWAYS PERFORM MARKOVNIKOV ADDITION OF WATER TO AN ALKENE

BUT WHEN I DO, I PREFER OXYMERCURATION
Question 6
MCalkenesIb

Which is the major product of the following reaction?

A

B

C

D

HCl

simple electrophilic addition to a C=C bond, Markovnikov, Cl adds to the most substituted "end" of the C=C bond, reaction proceeds via the most stable cation intermediate.

2 substituents at this "end", most substituted end

1 substituent at this "end" (H does not "count")

LB/BB

LA/BA

mechanism

LB

LA

3° cation and resonance stabilized (resonance contributors not shown)

Cl adds to most substituted end (reaction proceeds via most stable cation intermediate), thus Markovnikov
Question 7
MC26s

Which are the reagents and conditions that are most likely to give the products of the following reactions?

1) \[
\begin{array}{c}
\text{1. Hg(OAc)}_2/H_2O \\
\text{2. NaBH}_4
\end{array}
\]

2) \[
\begin{array}{c}
\text{H}_2\text{O} \\
\text{H}_2\text{SO}_4 \text{ (cat.)/heat}
\end{array}
\]

3) \[
\begin{array}{c}
\text{1. BH}_3/\text{THF} \\
\text{2. H}_2\text{O}_2/-\text{OH}
\end{array}
\]

A  Reaction 1) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4 \text{ (cat.)/heat}$
   Reaction 2) 1. Hg(OAc)$_2$/H$_2$O, 2. NaBH$_4$
   Reaction 3) 1. BH$_3$/THF, 2. H$_2$O$_2$/-OH

B  Reaction 1) 1. BH$_3$/THF, 2. H$_2$O$_2$/-OH
   Reaction 2) 1. Hg(OAc)$_2$/H$_2$O, 2. NaBH$_4$
   Reaction 3) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4 \text{ (cat.)/heat}$

C  Reaction 1) 1. Hg(OAc)$_2$/H$_2$O, 2. NaBH$_4$
   Reaction 2) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4 \text{ (cat.)/heat}$
   Reaction 3) 1. BH$_3$/THF, 2. H$_2$O$_2$/-OH

D  Reaction 1) 1. BH$_3$/THF, 2. H$_2$O$_2$/-OH
   Reaction 2) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4 \text{ (cat.)/heat}$
   Reaction 3) 1. Hg(OAc)$_2$/H$_2$O, 2. NaBH$_4$

$\text{H}_2\text{O}/\text{H}_2\text{SO}_4 \text{ (cat.)/heat}$ results in Markovnikov-type addition of H$_2$O, but involves a carbocation intermediate that will rearrange if possible, as in these reactions.

1. Hg(OAc)$_2$/H$_2$O, 2. NaBH$_4$ results in Markovnikov addition of H$_2$O across the C=C bond, but avoids a carbocation intermediate, rearrangements do not occur, **this is the preferred method for Markovnikov water addition, do NOT use aqueous acid in a synthesis problem**

1. BH$_3$/THF, 2. H$_2$O$_2$/-OH results in ANTI-Markovnikov addition of H$_2$O across the C=C bond, avoids a carbocation intermediate, rearrangements do not occur.
Question 8
MC26q
Which of the following is LEAST likely to be a product of the following reaction?

\[
\text{O}_2\text{O} \quad \text{H}_2\text{SO}_4 \quad \text{H}_2\text{O} \\
\text{A} \quad \text{B} \quad \text{C} \quad \text{D}
\]

\[\text{H}_2\text{O} \quad \text{H}_2\text{O} \quad \text{H}_2\text{O} \quad \text{H}_2\text{O} \]

A \quad B \quad C \quad D

hydride shift

hydride shift