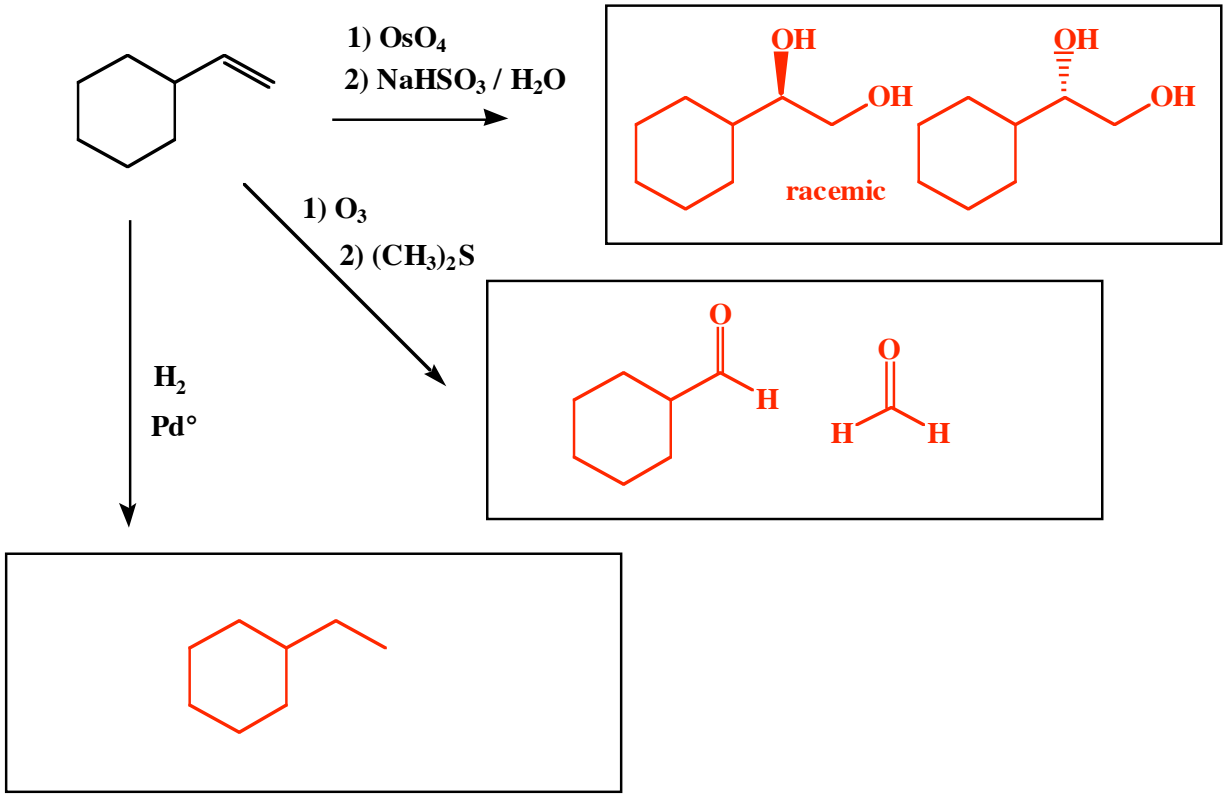
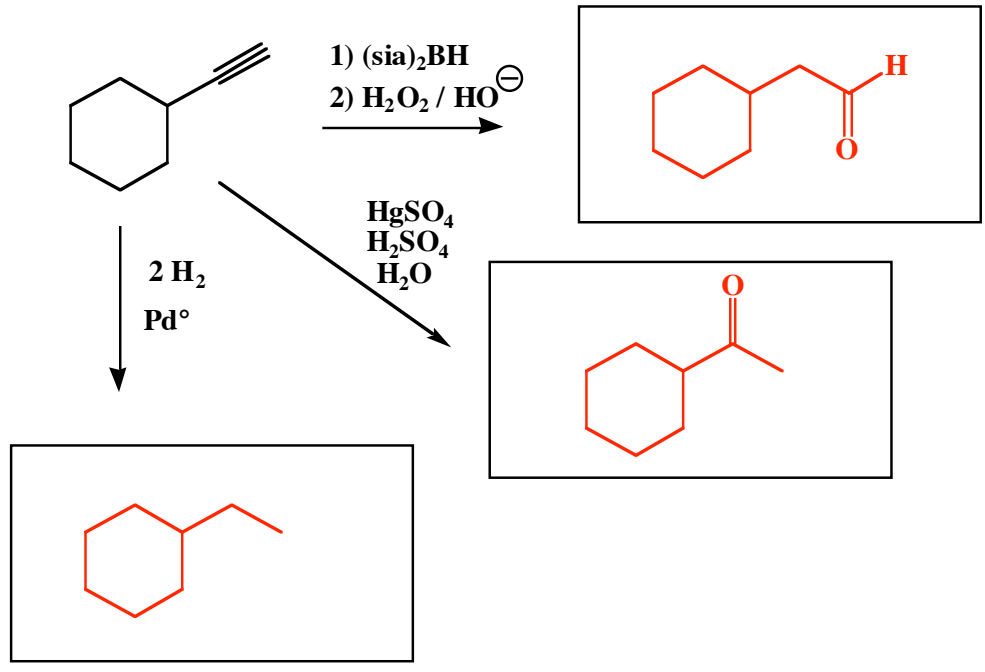
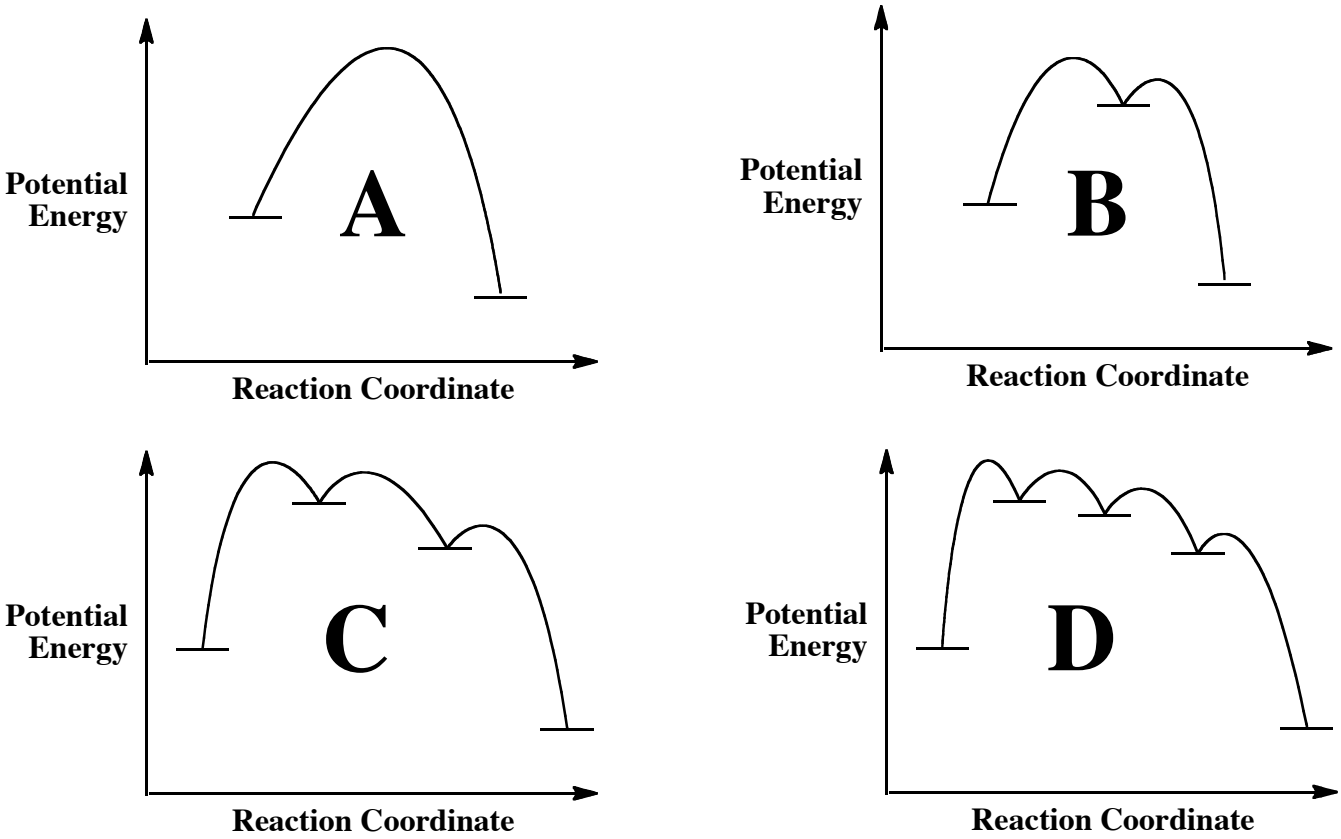
13. (3 or 5 pts each) **For the following, complete the reactions with the predominant carbon containing product or products.** You must indicate stereochemistry with wedges and dashes. If a racemic mixture is created, you must write "racemic" under the structures.

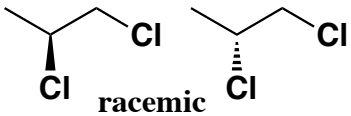




11. (8 pts.) Shown below are four different energy diagrams. Each is labeled with a letter. **Use these letters to answer questions at the bottom of the page,** ***and on the next TWO mechansim pages***.



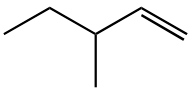
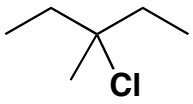
In the boxes provided, write the letter of the energy diagram that best describes the mechanism of the following reactions:

$CH_3CH{=}CH_2 + Cl_2 \longrightarrow$  racemic

B Energy Diagram Letter

$CH_3CH{=}CH_2 + HCl \longrightarrow CH_3CHClCH_3$

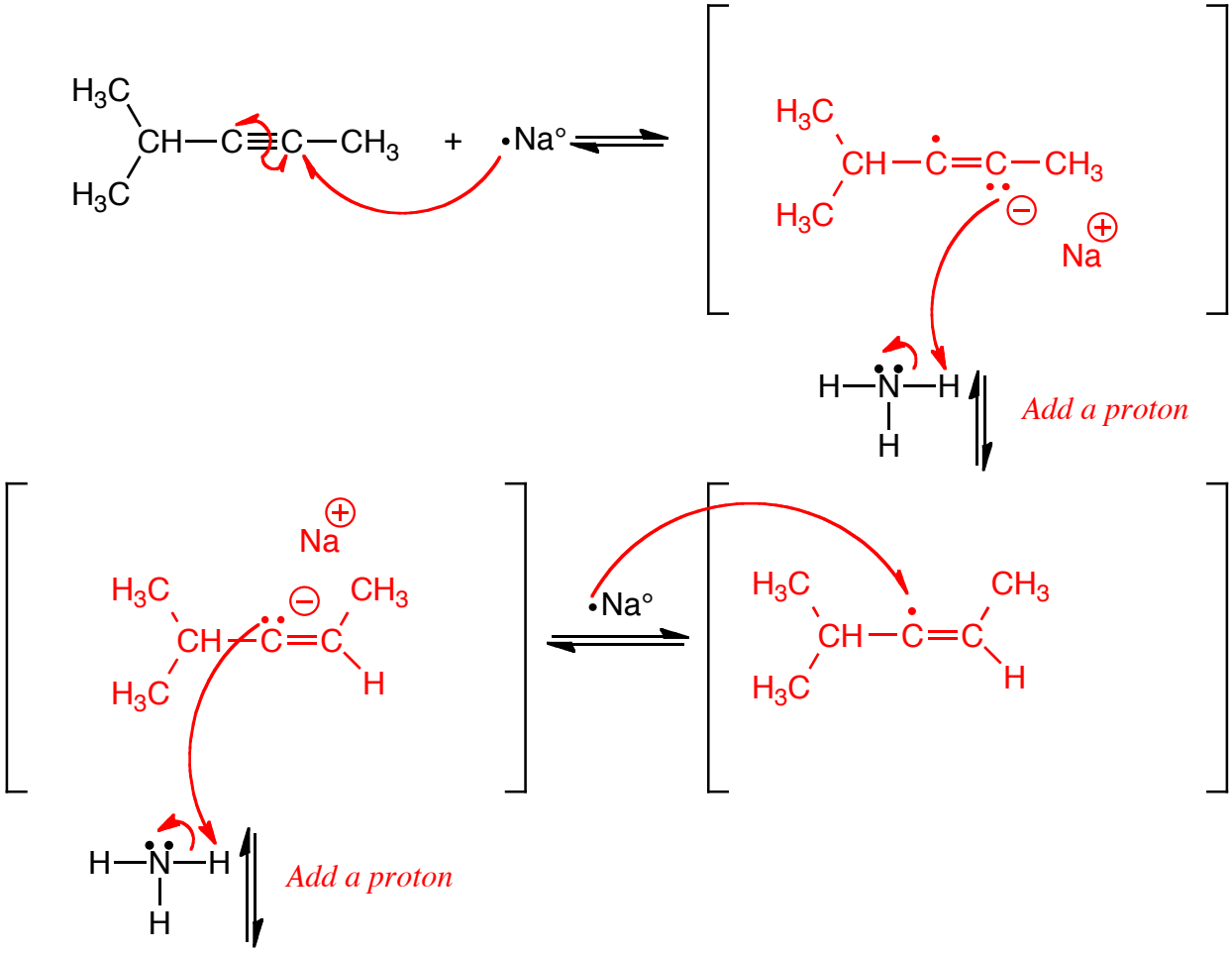
B Energy Diagram Letter

 + HCl $\longrightarrow$ 

C Energy Diagram Letter

(Rearranged!)

13. (28 pts total) Complete the following mechanism for the reduction of an alkyne using sodium and ammonia. Use appropriate arrows to show movement of electron density, and show all non-bonding electrons as dots and show any formal charges. **If any of the species are really a racemic mixtures of enantiomers, you only need to draw one stereoisomer and write "racemic"**



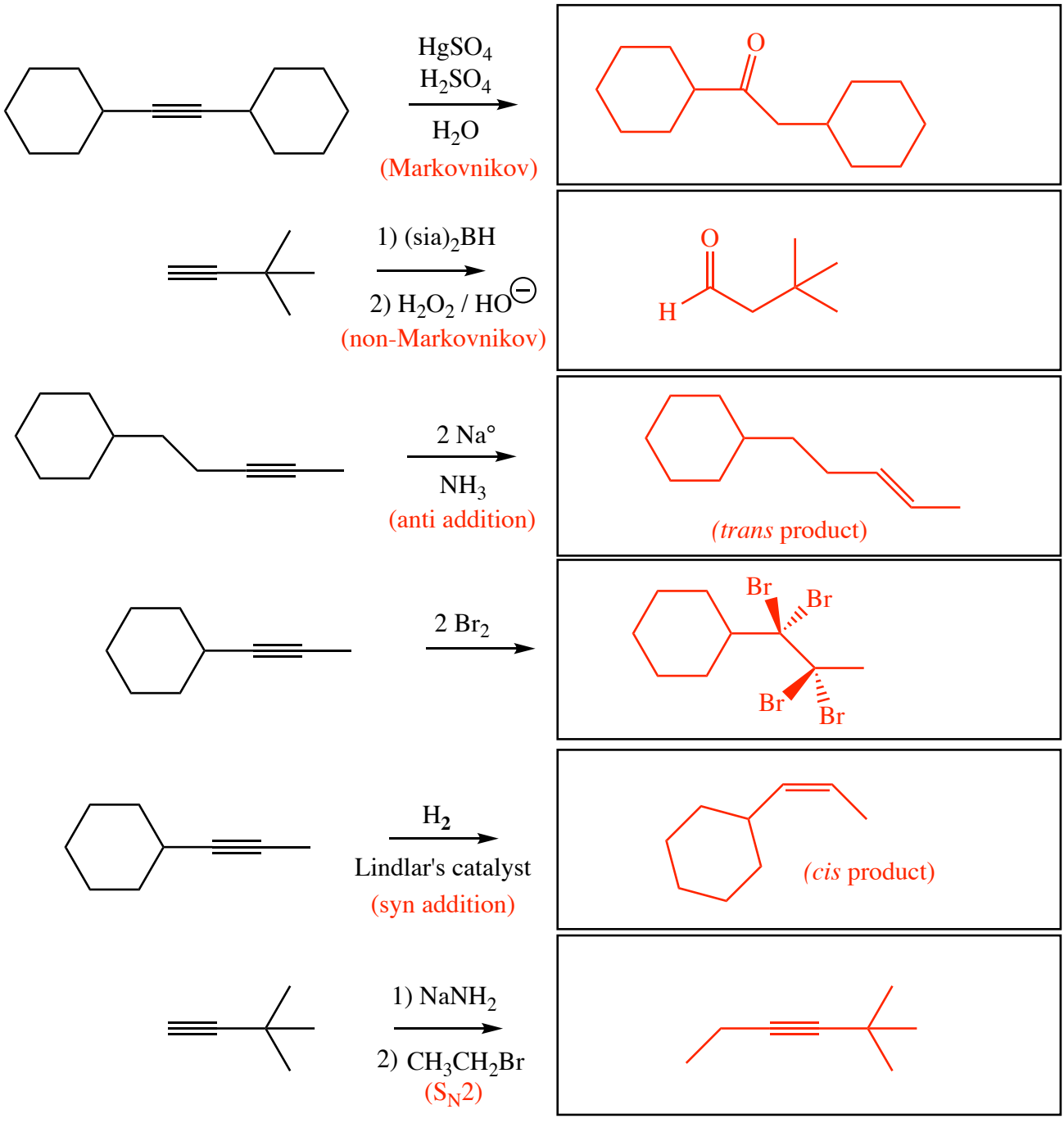
Products

Of the energy diagrams on the previous page, which one looks the most appropriate to describe this reaction (write the letter in the box that corresponds to the correct energy diagram)

D

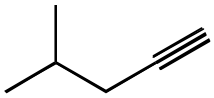
NOTICE THIS QUESTION AND THE TWO SIMILAR QUESTIONS ON TEH PREVIOUS PAGE!!

16. (3 or 5 pts each) Fill in the box with the product(s) that are missing from the chemical reaction equations. **Draw only the predominant regioisomer product or products (i.e. Markovnikov or non-Markovnikov, etc.)** and please remember that **you must draw the structures of all the product stereoisomers using wedges and dashes to indicate stereochemistry**. When a racemic mixture is formed, **you must write "racemic" under both structures EVEN THOUGH YOU DREW BOTH STRUCTURES**.



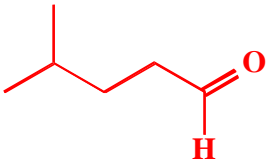
13 (cont.) (3 or 5 pts each) The following reactions all involve chemistry of alkenes. Fill in the box with the product(s) that are missing from the chemical reaction equations. **Draw only the predominant regioisomer product or products (i.e. Markovnikov or non-Markovnikov products)** and please remember that **you must draw the structures of all the product stereoisomers using wedges and dashes to indicate stereochemistry**. When a racemic mixture is formed, **you must write "racemic" under both structures EVEN THOUGH YOU DREW BOTH STRUCTURES**.

J.

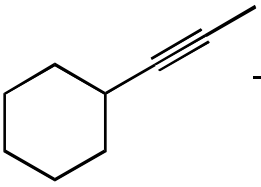


1) $(sia)_2BH$

2) H_2O_2 / $HO^{\ominus}$

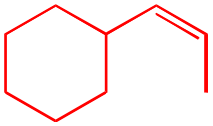


K.



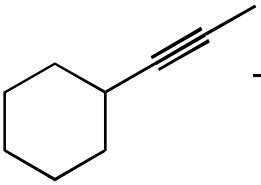
H_2

Lindlar's catalyst

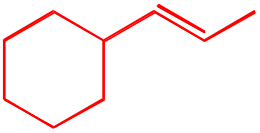


Z (syn addition)

L.

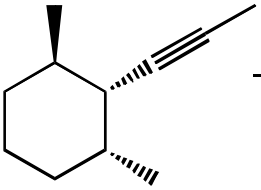


2 Na°, 2 NH_3



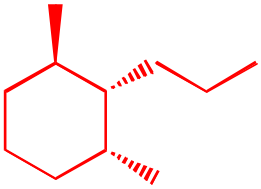
E (anti addition)

M.

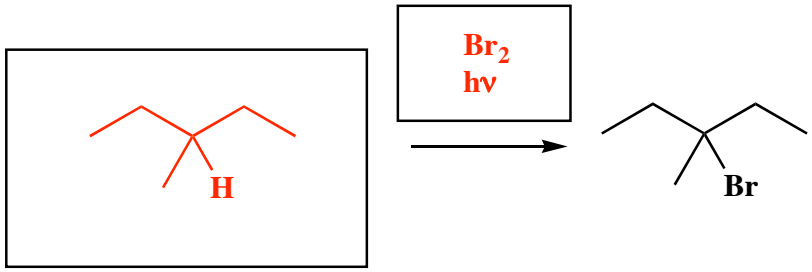


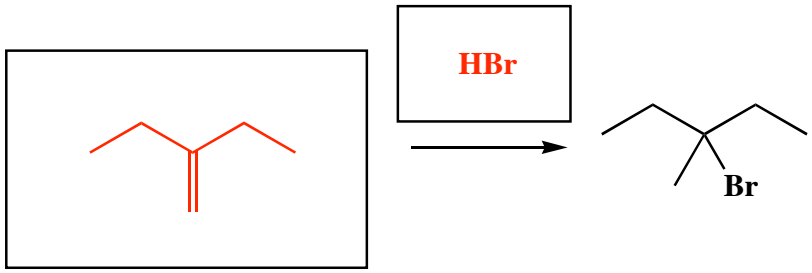
2 H_2

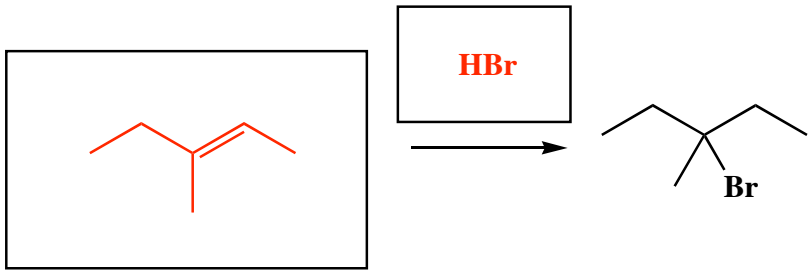
Pd°

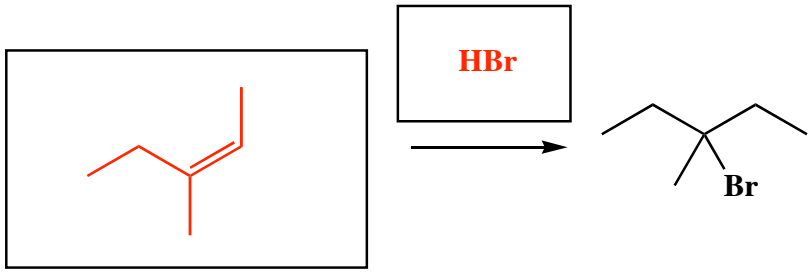


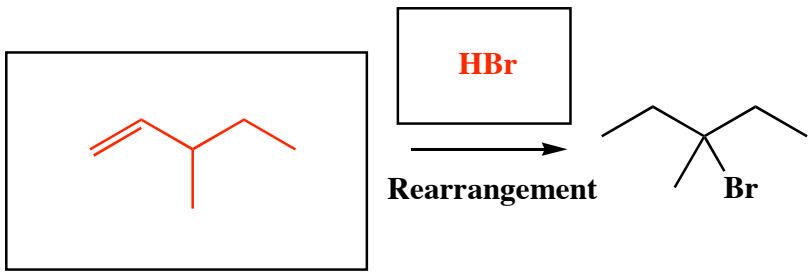
18. (15 pts) Save this until the end, because it may take you a while to find all the answers. One of the interesting aspects of organic synthesis is that sometimes you can make the same molecule several different routes. Propose five different syntheses of the following alkyl halide. To be considered a different route, at least one of your reactants must be different, although you can use the same reagent more than once. IN each case, the molecule shown is the only predominant product expected. Only the last reaction can involve a rearrangement, and in that case, you can presume that the major product is rearranged as long as your rearrangement corresponds to one we have seen in the course.





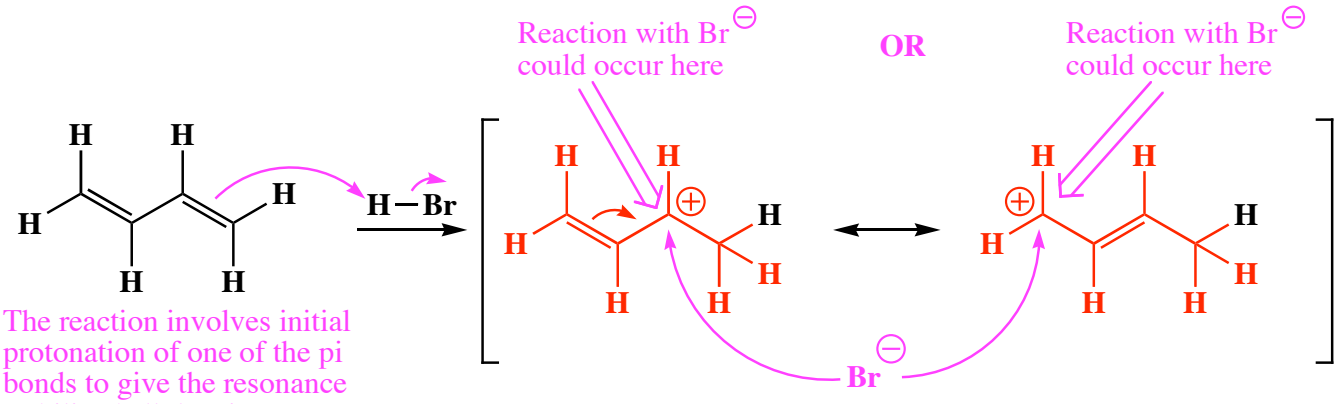






14. Here is an "apply what you know" question so save it until the end. You have not seen this before, but you have seen enough chemistry to understand it. **Including all regioisomers and stereoisomers, there are three major products of the following reaction.**

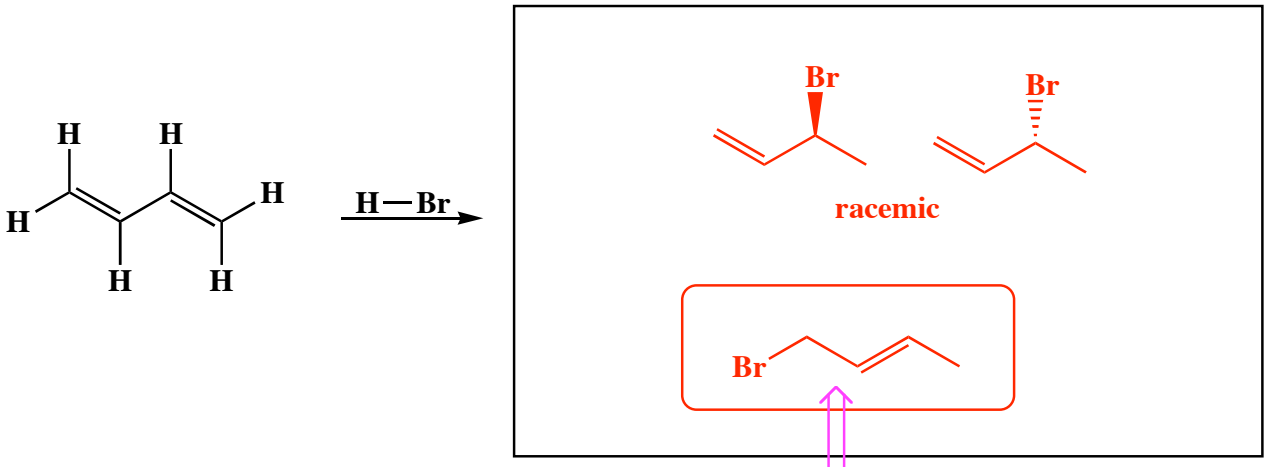
A) (6 pts) The products of this reaction are best understood by thinking through the possible resonance contributing structures for the key intermediate produced in the reaction. **In the space provided, draw the two most important contributing structures for the key intermediate.** *Hint: this part is intended to help you identify the three products in part C)*



The reaction involves initial protonation of one of the pi bonds to give the resonance stabilized allyl cation intermediate shown above.

This is an allyl cation, entirely analgous to the allyl radical you saw in the allylic radical halogenation reaction. Reaction with Br⊖ can take place at either of the two carbons with the partial positive charge, leading to the products shown below in part B).

B) (9 pts) In the space provided, draw all three products. ***Assume the HBr only adds once to the alkene molecule!!!!***

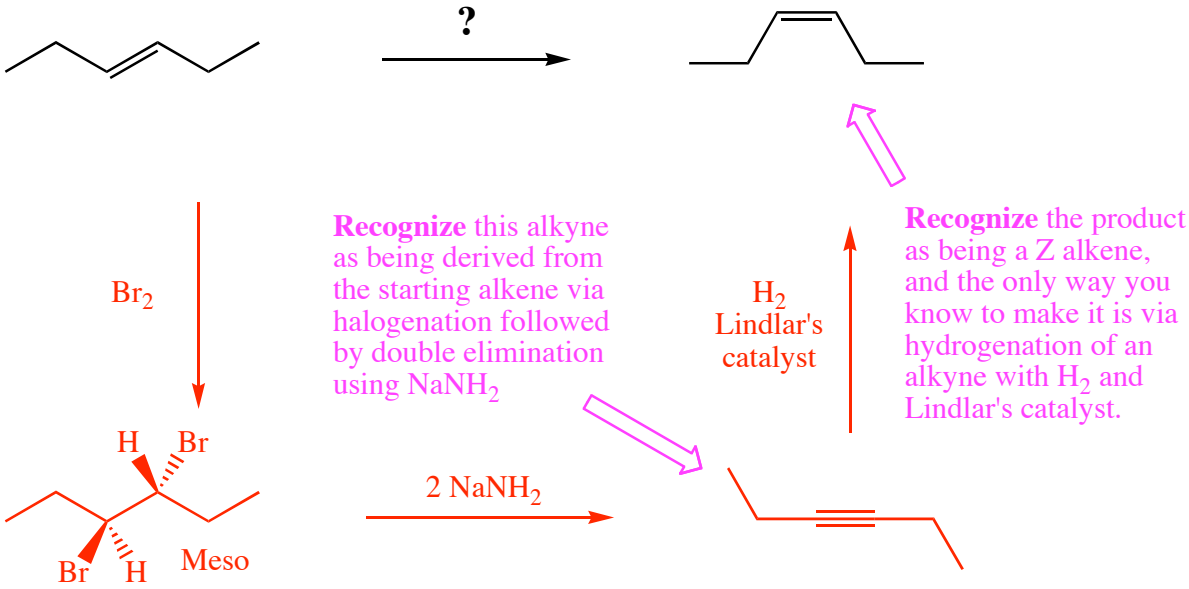


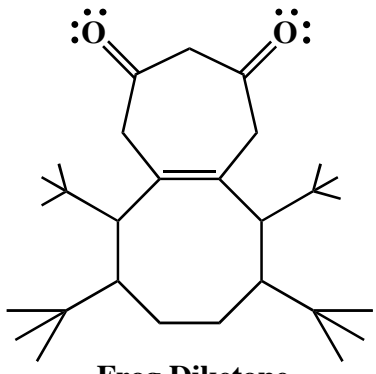
This has a more highly substituted double bond so it is the most stable

C) (2 pts) One of the three is of lower overall energy than the others (i.e. more stable product). **Circle the lowest energy product.**

17. (cont.) These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned provided that the product(s) you draw for each step is/are the predominant one(s). Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate.

E) (8 pts)





Frog Diketone

This is not part of a question. This little molecule creature is simply supposed to make you smile!