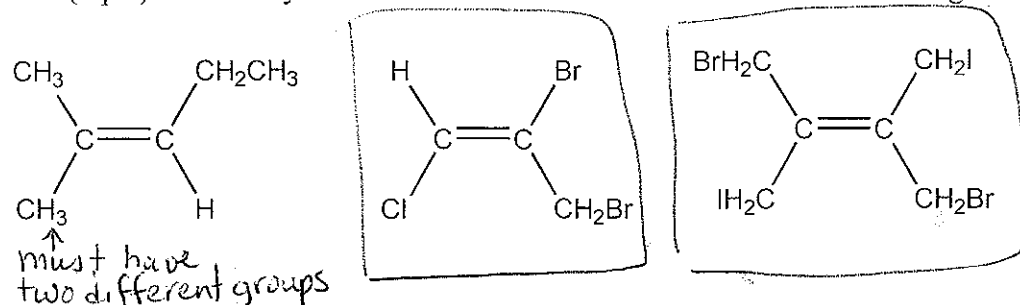
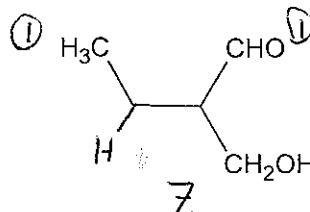
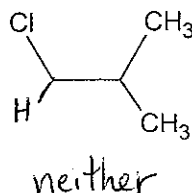
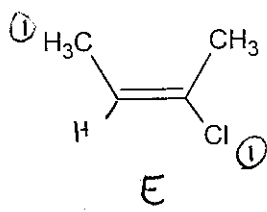


1. (3 pts) Circle any of the alkene structures shown below which have geometric isomers.

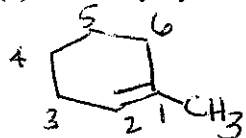


2. (3 pts) Label each alkene as Z, E, or neither:



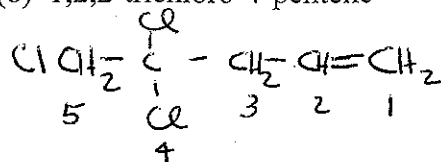
3. (6 pts) The following names are incorrect IUPAC names. Draw the structure implied by this name, indicate why the given name is incorrect and write the correct name for each structure.

(a) 2-methylcyclohexene



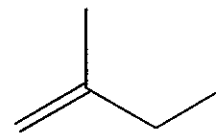
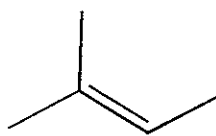
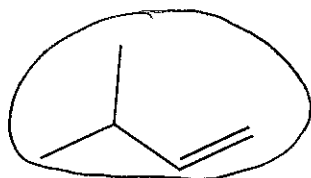
The  $\text{CH}_3$  group needs to have the lowest possible number  
1-methylcyclohexene

(b) 1,2,2-trichloro-4-pentene



4,4,5-trichloro-1-pentene  
 $\text{C}=\text{C}$  should have lowest possible number

4. (2 pts) Circle the compound that has the highest heat of hydrogenation.

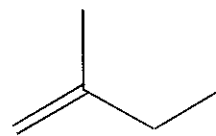
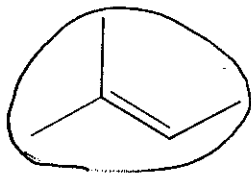
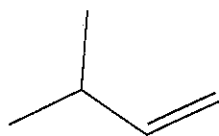


monosubstituted  
 least stable - highest energy  
 highest heat of hydrogenation

trisubstituted

disubstituted

5. (2 pts) Circle the compound that reacts most slowly when hydrogenated using hydrogen and a palladium on charcoal catalyst.



6. (4 pts) Calculate the number of degrees of unsaturation for each molecular formula.

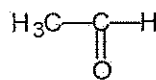
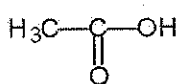
(a)  $C_6H_8$      3      $C_6H_{14}$       $14-8=6$       $C_nH_{2n+2}$

(b)  $C_8H_9Br$      4      $C_8H_{18}$       $18-10=8$   
↑ counts same as H

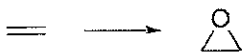
7. (10 pts) Classify each of the following transformations as oxidation, reduction or neither.



oxidation



reduction



oxidation



reduction



reduction

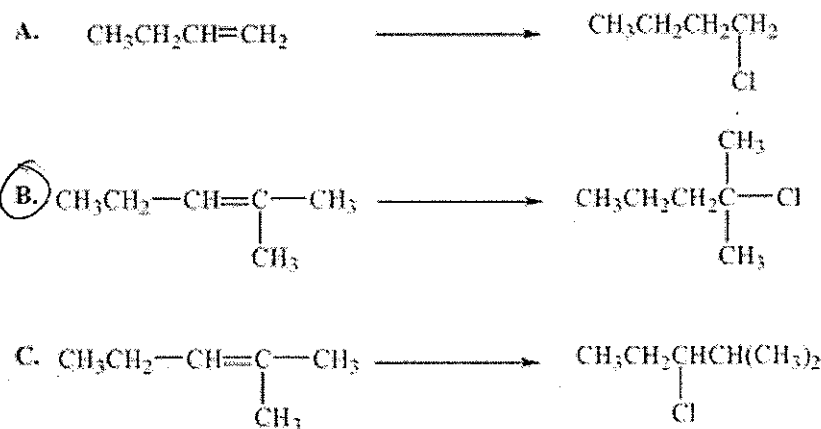
8. (2 pts) A compound J, with a molecular formula  $C_8H_{12}$ , reacts with an excess of  $H_2$  in the presence of a palladium catalyst to give a new compound having the molecular formula  $C_8H_{18}$ . Compound J does not react with sodium in liquid ammonia. What can be said about the structure of J? Circle the correct response.

- one  $C=C$   $\leftarrow$   $C_8H_{14}$   $\leftarrow$   $C_8H_{18}$   
 no  $C\equiv C$   $C_8H_{12} \Rightarrow 18-12=6$  or  $3$  degrees unsat.
- A. J has 3 rings.  
 B. J has 1 ring and 2 double bonds.  
 C. J has 2 rings and 1 double bond.  
 D. J has 3 double bonds.  
 E. It's impossible to say anything about the structure of J given this data.

9. (2 pts) Rearrangements can occur in which of the following reactions? Circle your response.

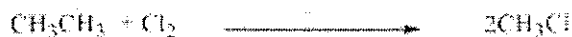
- $\rightarrow$  occurs when there is an open carbocation
- A. Acid-catalyzed addition of  $H_2O$  to an alkene  
 B. E2 elimination  
 C. Free radical halogenation of alkanes  
 D. Addition of  $Cl_2$  to an alkene  
 E. None of the choices is correct.

10. (2 pts) Which of the following reactions is an example of Markovnikov's rule? Circle your response.

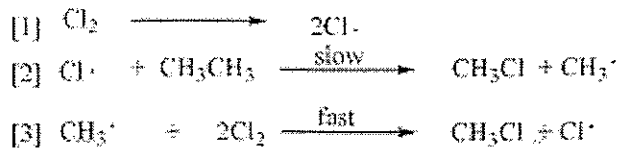


H adds to carbon with the most H to get more stable carbocation

11. (4 pts) Consider the following possible reaction of ethane with chlorine:

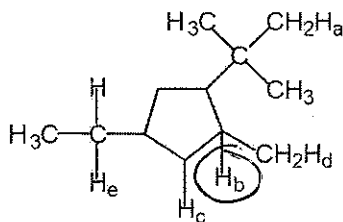


This reaction could conceivably occur by the following chain mechanisms [1], [2] and [3].



Answer the following questions about this mechanism by placing the number identifier for the steps in the blank provided.

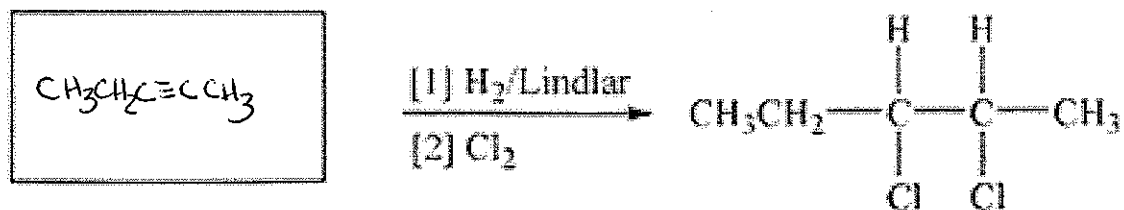
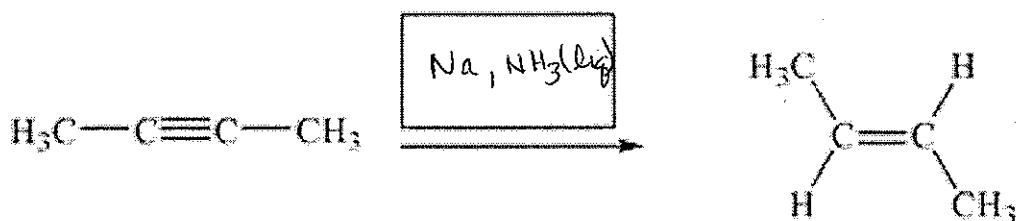
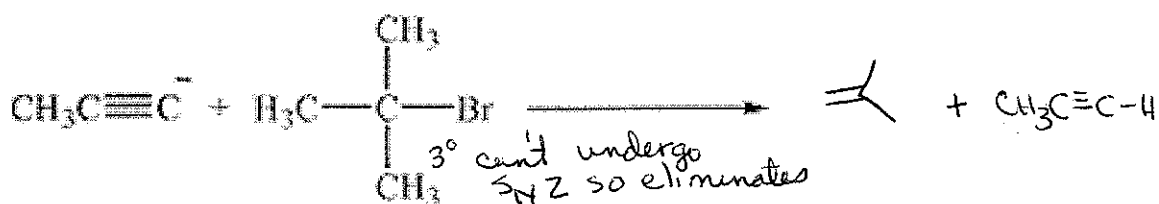
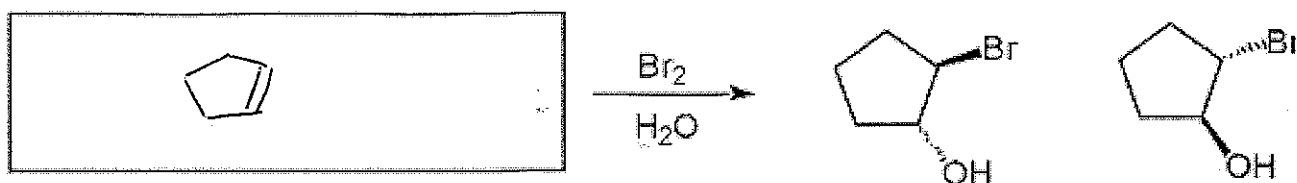
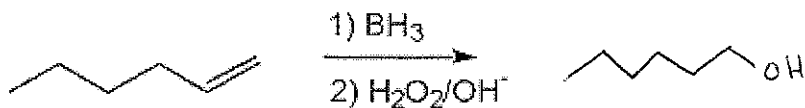
- (a) The chain initiating step(s) is/are: 1
- (b) The chain propagating step(s) is/are: 2+3
- (c) What step or steps would be considered chain terminating? none
12. (2 pts) Which of the labeled hydrogens (those labeled a-e) is most easily abstracted in a free radical bromination reaction? Circle your answer.

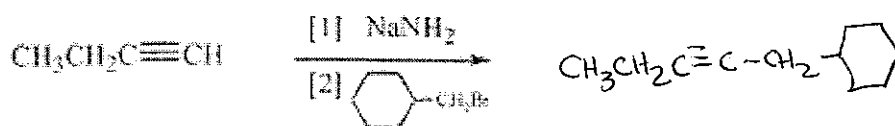
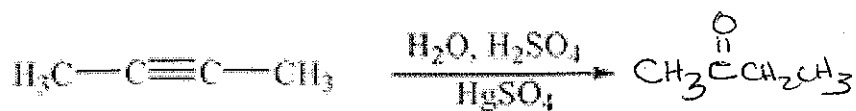


13. (6 pts) Indicate if the following reactions will occur by syn-addition, anti-addition or no stereospecificity.

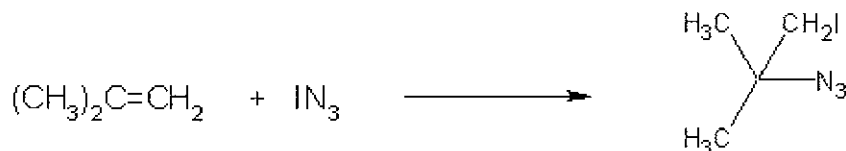
- (a) addition of HBr to an alkene none
- (b) dissolving metal reduction anti
- (c) hydroboration-oxidation syn
- (d) chlorination of an alkane ~~anti~~ none
- (e) bromination of an alkene anti
- (f) hydrogenation of an alkene syn

14. (24 pts) Complete the following reactions. You must show correct regiochemistry and stereochemistry where appropriate.

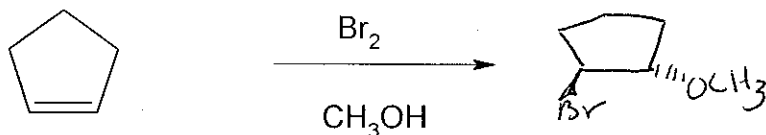




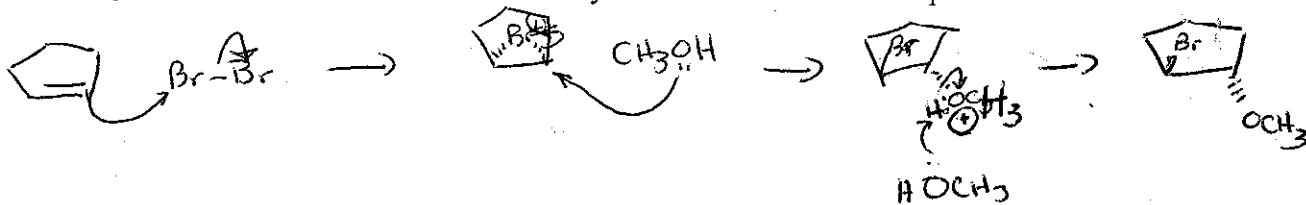
15. (2 pts) Identify the nucleophile in the following electrophilic addition reaction. Circle the correct response in the list below.



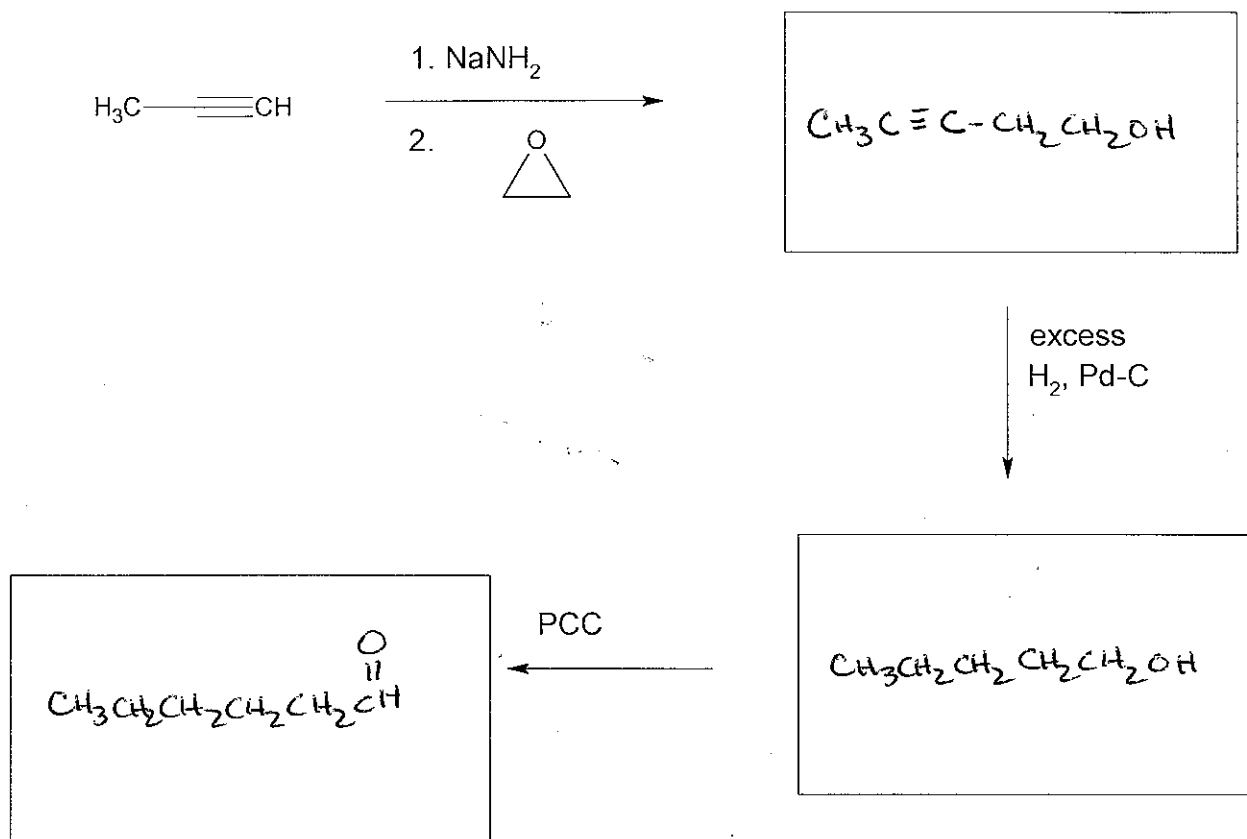
16. (6 pts) Show the product of the following reaction. Your answer must show the stereochemistry of the product.



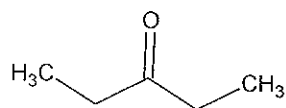
Draw a detailed mechanism for the process. All electron movement must be clearly shown, and all arrows must be drawn correctly to receive credit for this problem.



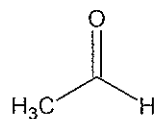
17. (6 pts) Complete the following reaction sequence.



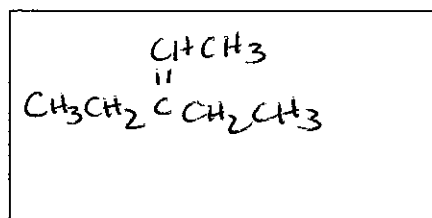
18. (4 pts) A tertiary alcohol was dehydrated to give an alkene. Treatment of the alkene with ozone, then with water and zinc, gave equal amounts of 3-pentanone and acetaldehyde. What are the structures of the alkene and the alcohol?



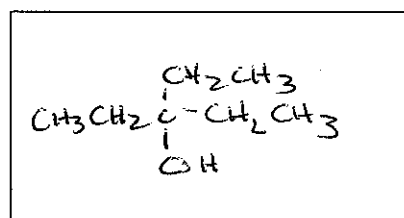
3-pentanone



acetaldehyde

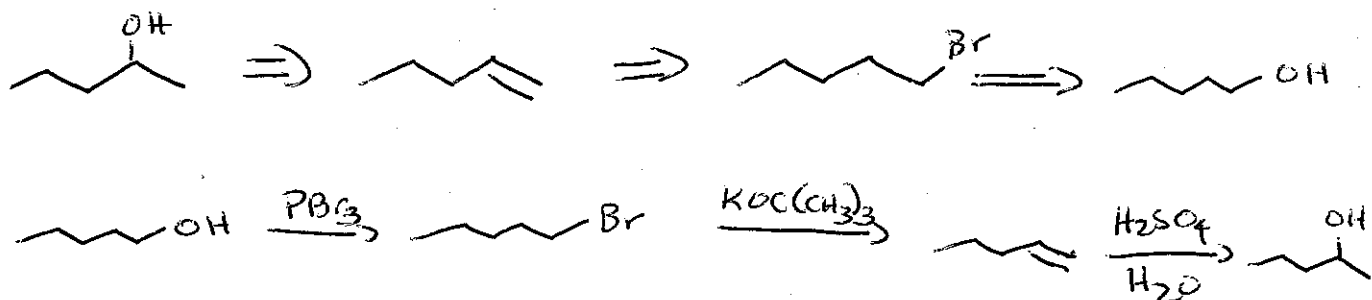


Alkene

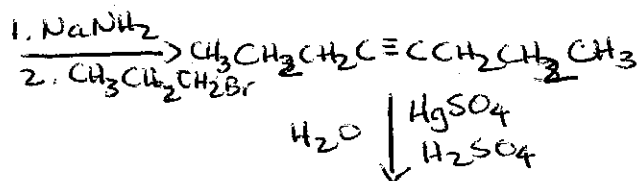
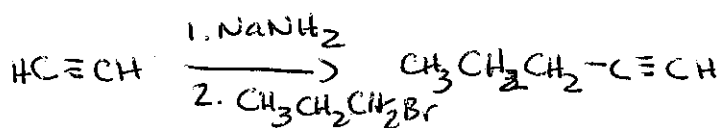
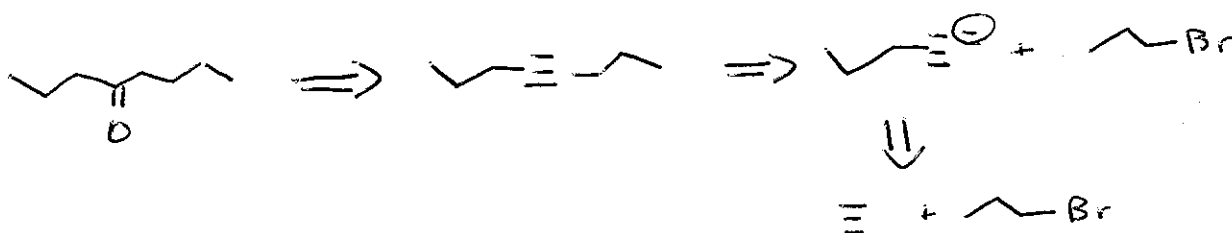
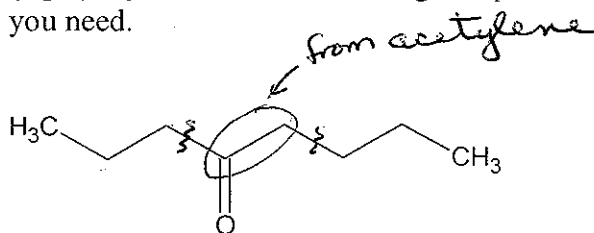


Alcohol

19. (4 pts) Synthesize 2-pentanol from 1-pentanol using any reagents you need.



20. (6 pts) Synthesize the following compound from acetylene and any other reagents that you need.



There are other acceptable halides that can be used to get to the long chain alkyne

