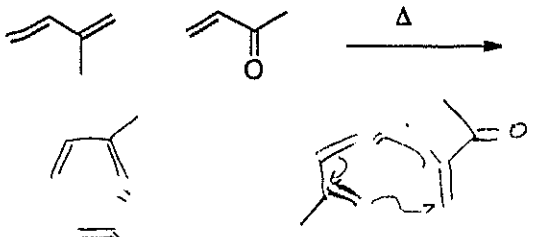
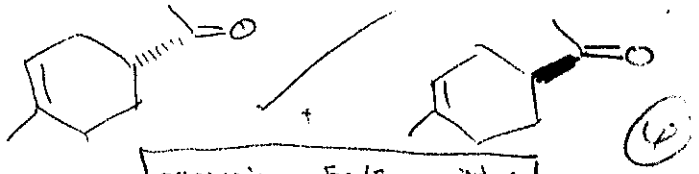
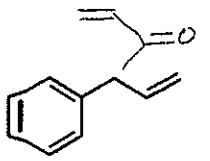
1 Provide the products of the following reactions. If a reaction would produce stereoisomers, draw the isomers and indicate if they will be produced in equal or unequal amounts (4 pts each).

a)

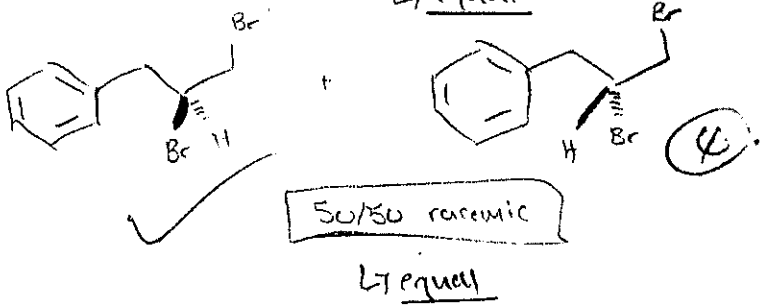




b)

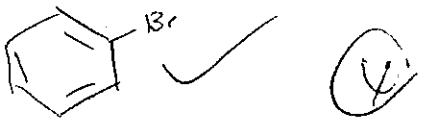


Br_2 (1 equiv)



c)

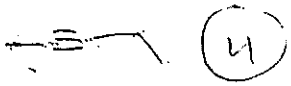
Br_2 / $FeBr_3$



d) $H_3C-\equiv-H$

1) BuLi

2) CH_3CH_2Br

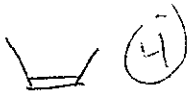


e) $H_3C-\equiv-CH_3$

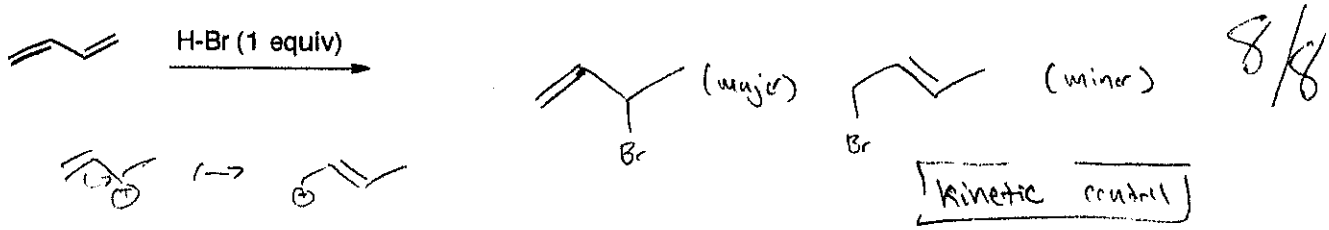
Na / NH_3

f) $H_3C-\equiv-CH_3$

H_2 / Lindlar's catalyst



2a) Provide the major and minor products expected from the reaction shown below and indicate which is major and which is minor (6 points):
b) Is this reaction under kinetic or thermodynamic control (2 points)?

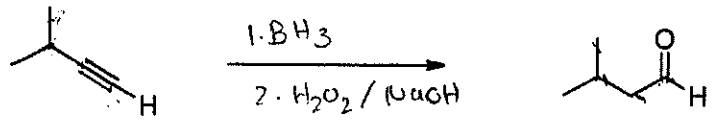


8/8

3) Complete the following syntheses using any organic molecule of 4 carbons or less and any reagents you need. You do not have to show the synthesis of the 4-carbon or less molecule you use. If your synthesis requires more than one step, provide the product after each step. All chiral products are racemic mixtures.

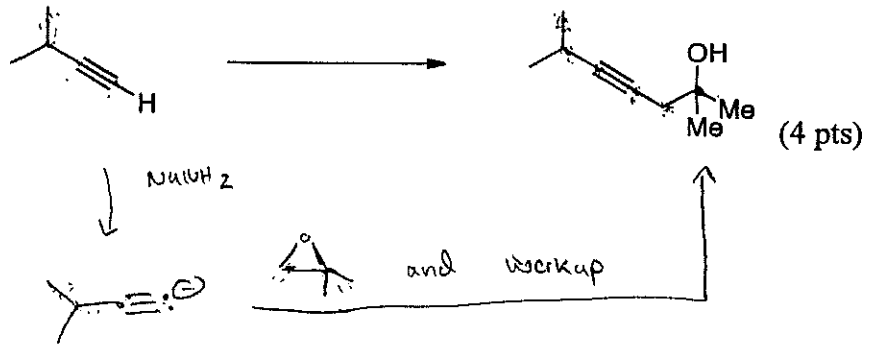
4/4

a)



(4 pts)

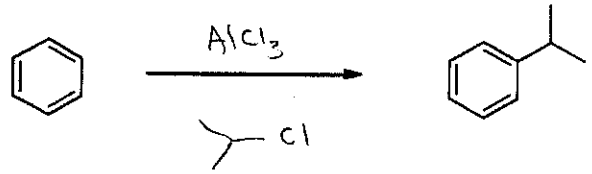
b)



(4 pts)

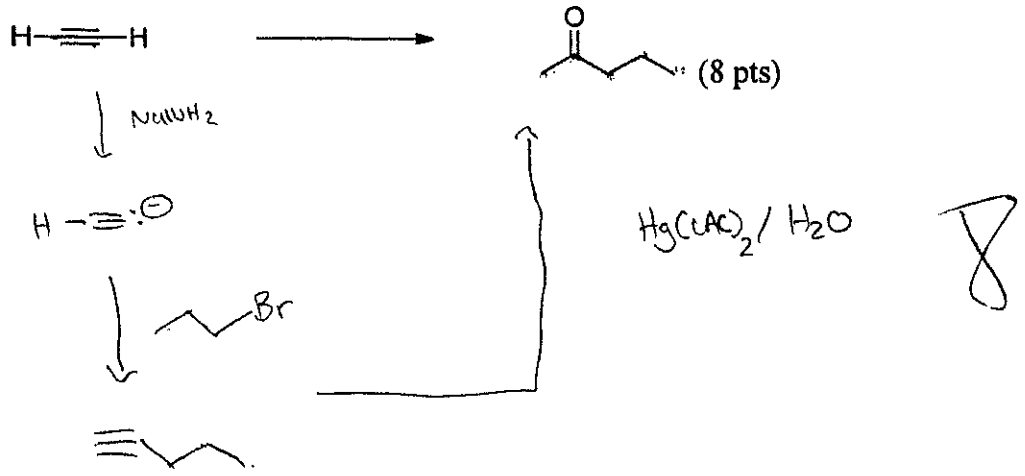
4

c)

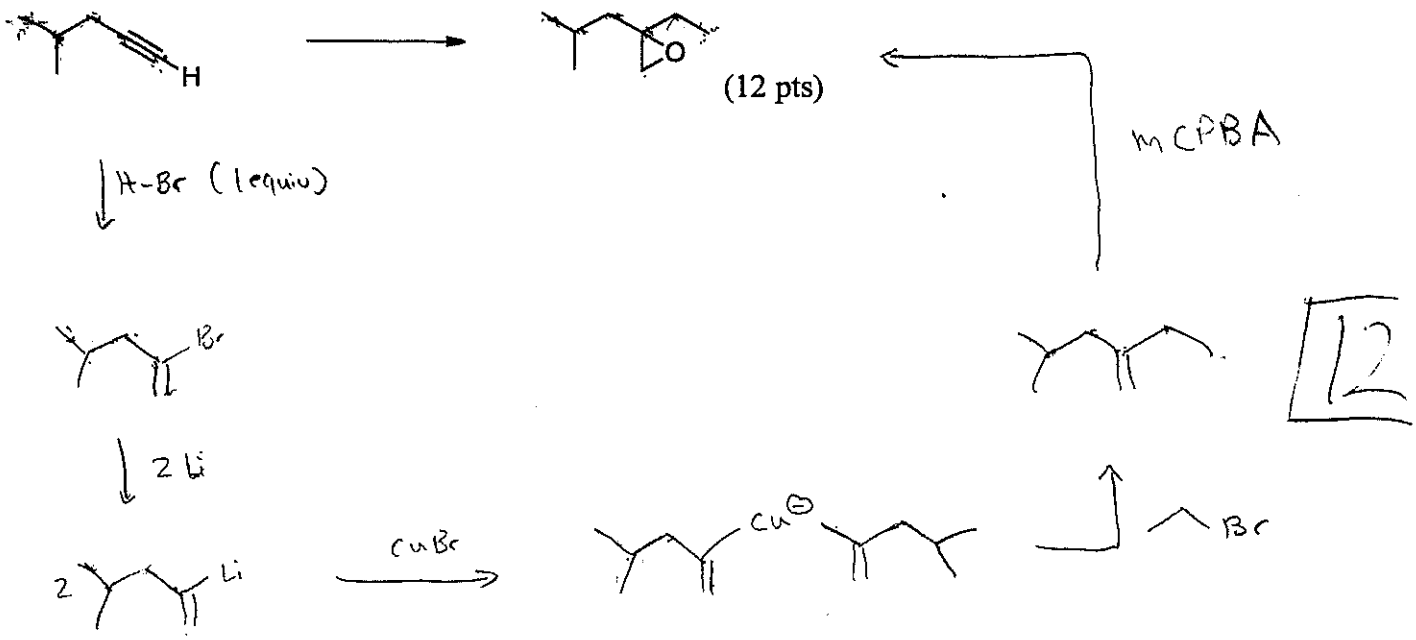


(4 pts)

4

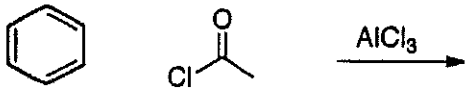
d) 

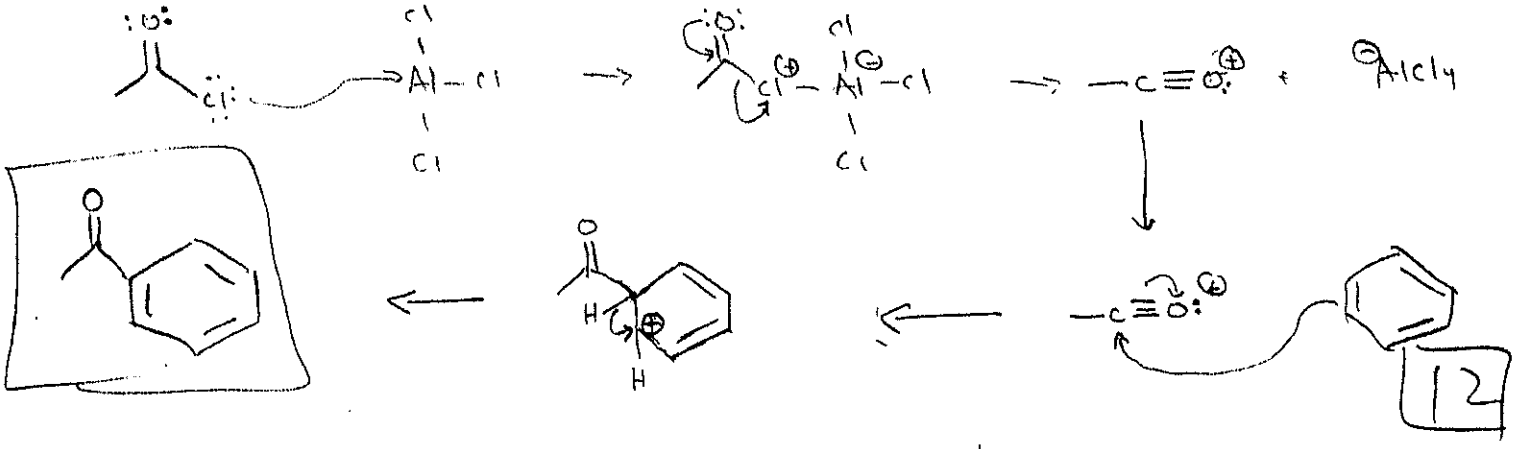
(8 pts)

e) 

(12 pts)

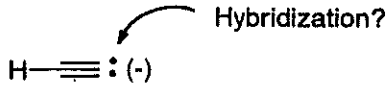
3) Provide the products and mechanisms for the following reactions. Show every intermediate with the proper charges and all the arrows required for each step of the reaction (4 pts for product, 8 pts for mechanism)





3a) What is the approximate pKa of acetylene? (2 pts) 25

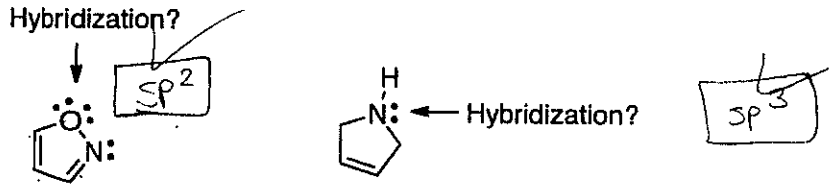
b) For the conjugate base of acetylene (shown below), what is the hybridization of the orbital containing the lone pair (circle one)? (2 pts) lone pair



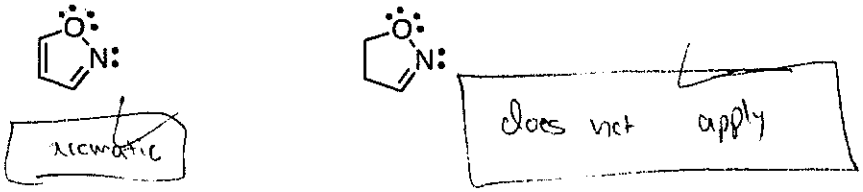
S P SP SP^2 SP^3

H—C≡C:⊖

4a) Provide the hybridization of the **atoms** indicate with an arrow below (not the lone pair orbitals, but the atoms). (2 pts each) 12

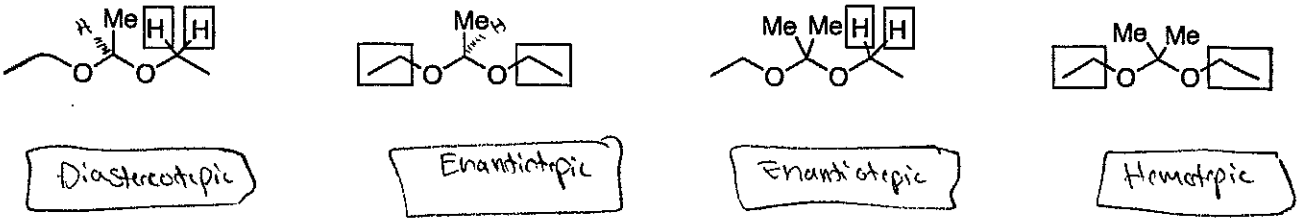


b) Are the following molecules aromatic, anti aromatic, or does this designation not apply? (2 pts each)



5) Label the boxed groups as homotopic, enantiotopic, diastereotopic or does not apply. (2 pts each)

18



Diastereotopic | Enantiotopic | Enantiotopic | Homotopic

6) Butadiene has four π-orbitals called π1 π2 π3 and π4. π1 is lowest in energy and π4 highest. The p orbital systems for π2 and π3 are shown below but without the phase designations (π1 and π4 are not shown). Provide the phase (+ or -) for each lobe (2 pts each)

4