

1. (20 points) Multiple choice. Circle the one best answer for each problem below.

A. Calculate SODAR for $C_7H_{11}Cl$

$$(7 \times 2) + 2 - 12 / 2$$

i. 0

ii. 1

iii. 2

iv. 3

v. 4

$$\text{SODAR} = 4$$

B. A compound with the formula $C_{10}H_{14}$ reacts with excess hydrogen and a catalyst to give a new compound with the formula $C_{10}H_{18}$. The compound could have:

$$\text{SODAR} = 2$$

i. one ring and three double bonds

ii. two rings and two double bonds

iii. two rings and a triple bond

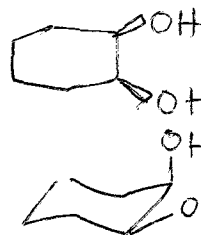
iv. no rings and two double bonds

v. more than one of the above

(two rings + two π bonds)

C. Cyclohexene is treated with cold, dilute, basic $KMnO_4$. The spatial arrangement of the two hydroxyl groups in the product will be:

Syn



i. Equatorial-axial

ii. Axial-axial

iii. Equatorial-equatorial

iv. Coplanar

v. trans

D. Which can exist as E/Z isomers?

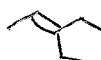
i. 1-pentene

ii. 3-hexene

iii. cyclopentene

iv. 2-methyl-2-butene

v. 3-ethyl-2-pentene



E. Markovnikov addition of HCl to propene involves:

i. initial attack by a chloride ion

ii. initial attack by a chlorine atom

iii. isomerization of 1-chloropropane

iv. formation of a propyl cation

v. formation of an isopropyl cation

F. The ozonolysis of an unsymmetrical, unbranched alkene forms:

i. A single aldehyde

ii. An aldehyde and a ketone

iii. Two different ketones

iv. Two different aldehydes

v. A single ketone



G. Your task is to convert 2-bromobutane to 1-butene in the highest yield. Which reagents would you use?

i. KOH/H₂O

iv. CH₃CH₂ONa/CH₃CH₂OH

ii. KOH/CH₃OH

v. (CH₃)₃COK/(CH₃)₃COH

iii. CH₃ONa/CH₃OH

bulky base

H. Predict the splitting pattern you would observe for the proton at C3 of 2,3-dimethyl-2-phenylbutane

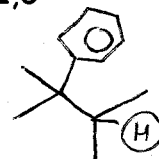
i. doublet

ii. singlet

iii. quartet

iv. septet

v. octet



6 neigh.

I. How many ¹H NMR signals would you expect to find in the spectrum of CH₃OCH₂CH₂OCH₃?

i. 1

ii. 2

iii. 3

iv. 4

v. 5

J. The intensities of a four-line splitting pattern (quartet) are approximately:

i. 1:1:1:1

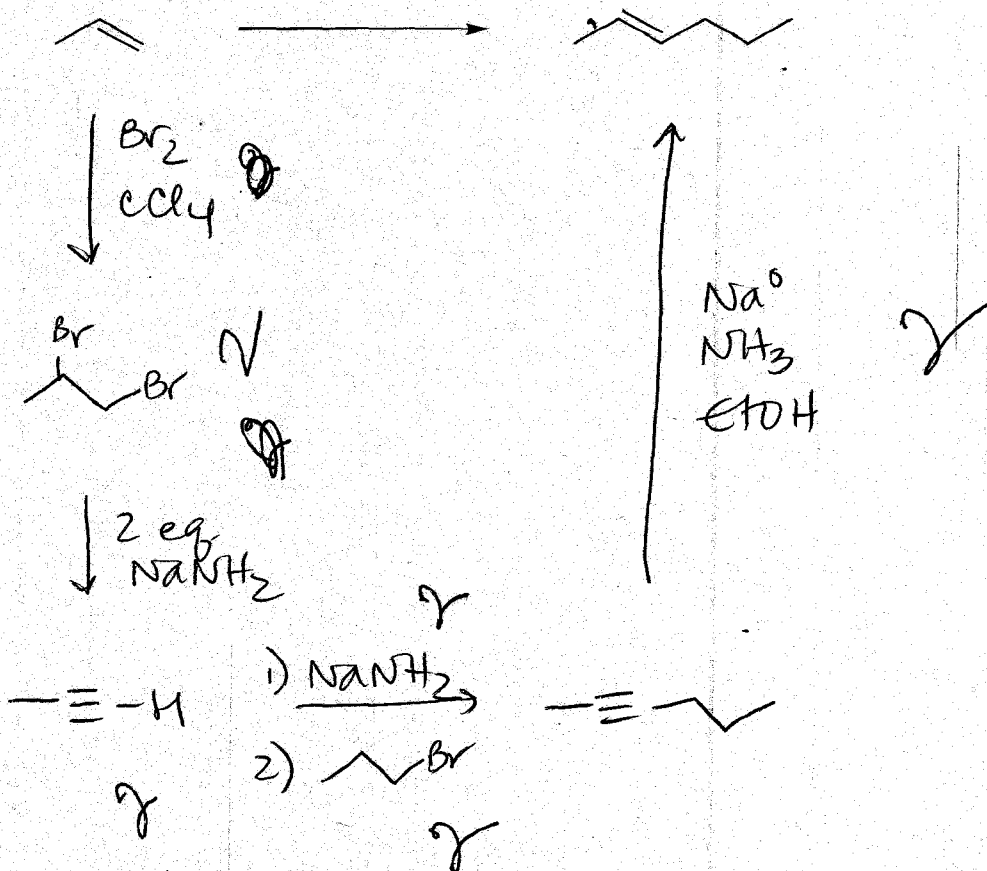
ii. 1:2:2:1

iii. 1:3:3:1

iv. 1:4:4:1

v. unpredictable

2. (10 points) Synthesis! Show how to accomplish the conversion given below. Show all isolable intermediates and be as specific as possible in reagents and reaction conditions. No mechanisms, please.



SODAR = 2

π bonds

3. (15 points) You are given three compounds, F, G, and H. All three have the molecular formula C_6H_{10} , and all three rapidly decolorize Br_2 in CCl_4 . F has an IR absorption near 3300 cm^{-1} ; G and H do not. F and G react with excess H_2/Pd to give hexane. H absorbs one equivalent of H_2 under the same conditions to give a compound with the formula C_6H_{12} . When F is treated with hot, basic $KMnO_4$ followed by an acidic workup, the only organic compound that can be isolated is $CH_3CH_2CH_2CH_2CO_2H$. Under the same conditions, G gives only $CH_3CH_2CO_2H$, and H gives $HO_2CCH_2CH_2CH_2CH_2CO_2H$. What are F, G, and H?

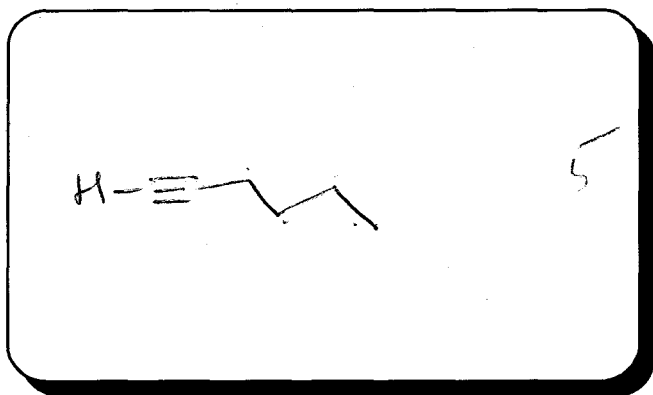
term.

alkyne

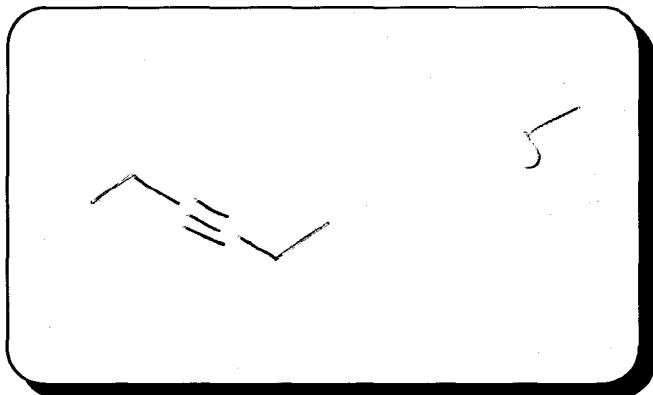
Answer:

F + G are
alkynes

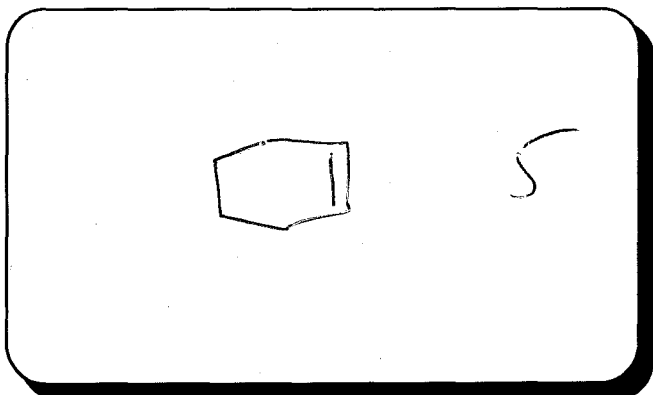
H is a
cycloalkene



F



G

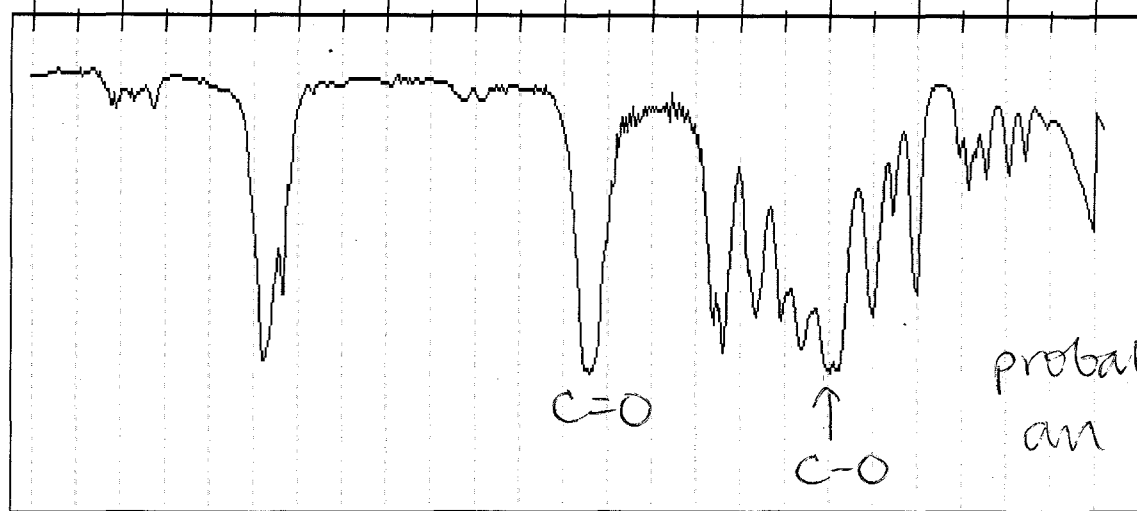


H

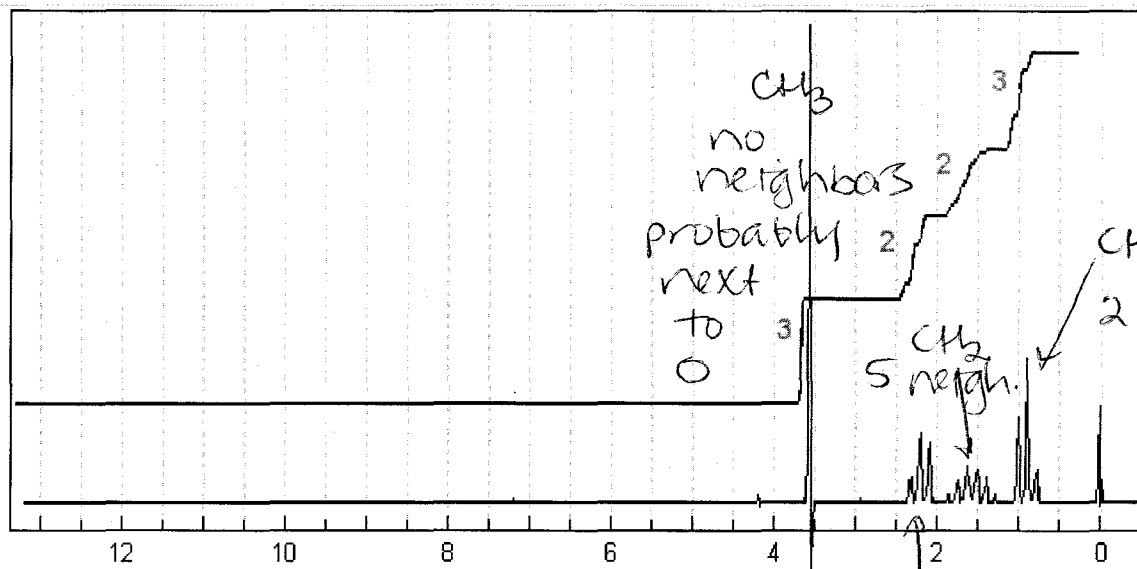
4. (12 points) Shown below are IR and ^1H NMR spectra for an unknown compound, formula $\text{C}_5\text{H}_{10}\text{O}_2$. Deduce the structure of the compound, indicating as much of your reasoning as possible. Don't forget SODAR.

SODAR = 1

4000 3600 3200 2800 2400 2000 1800 1600 1400 1200 1000 800 600



probably an ester



CH₃
no neighbors
probably next to O

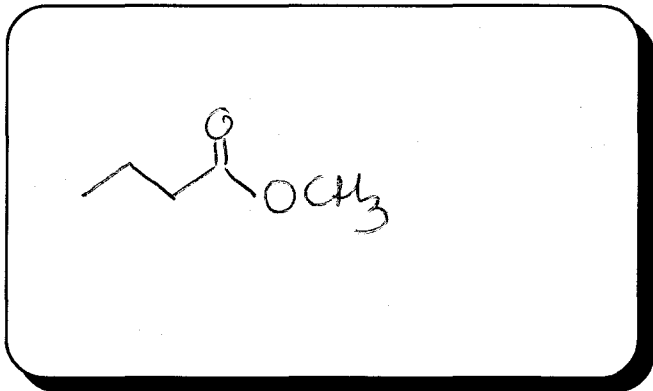
CH₂ 5 neigh.

CH₂ 2 neigh.

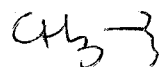
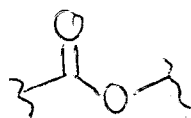
CH₃ 2 neigh.

<- Answer

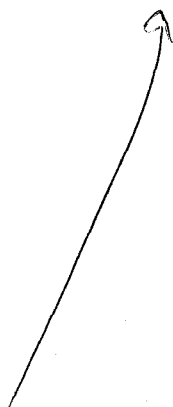
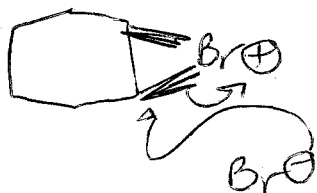
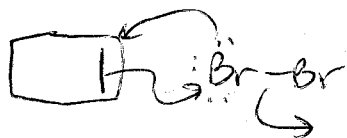
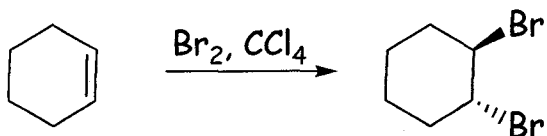
CH₂ 2 neigh.



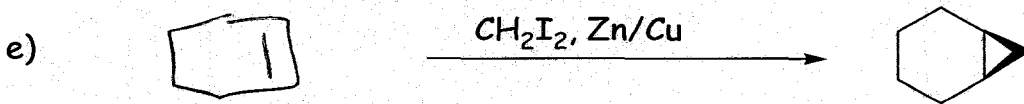
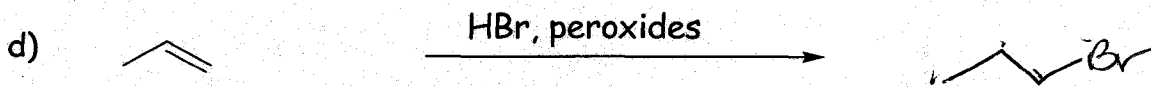
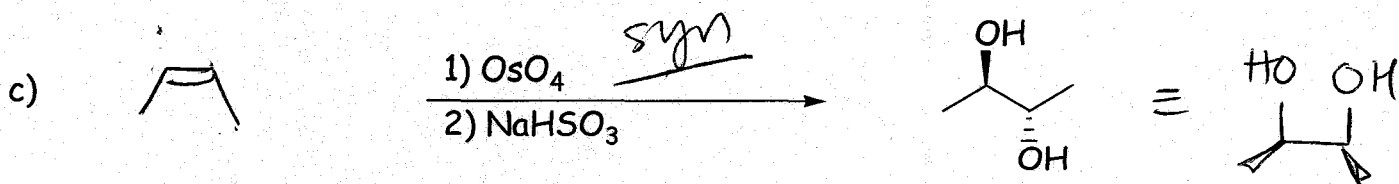
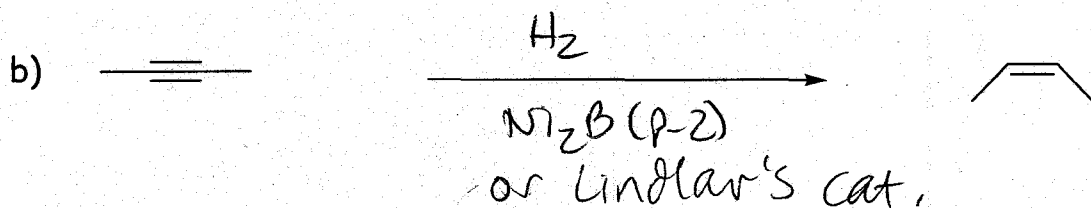
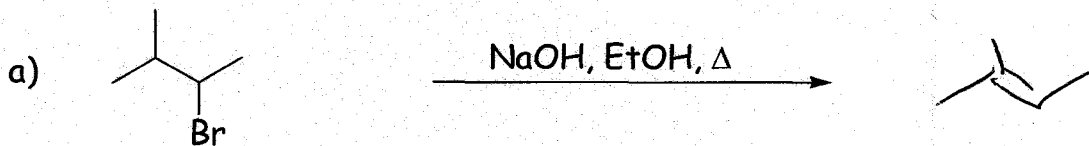
Fragments:

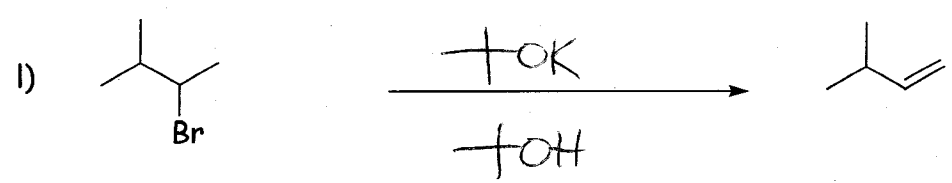
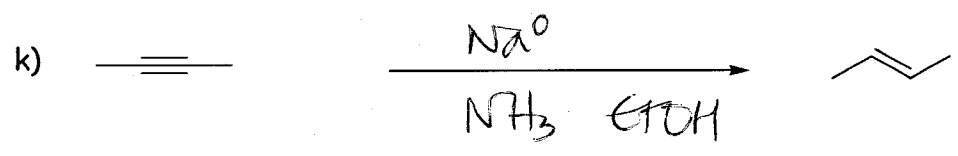
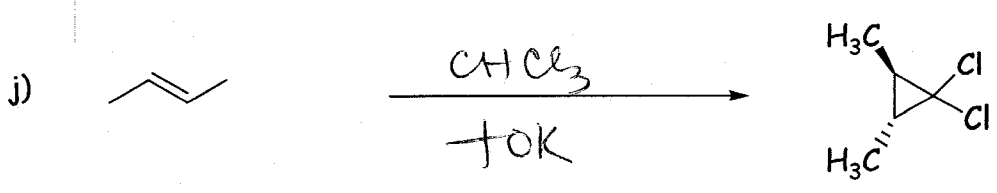
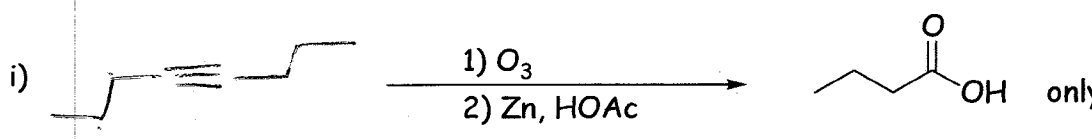
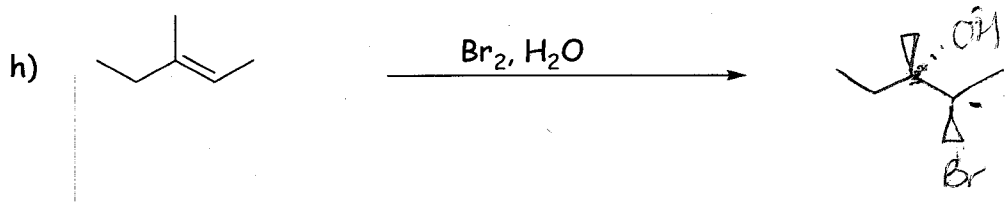
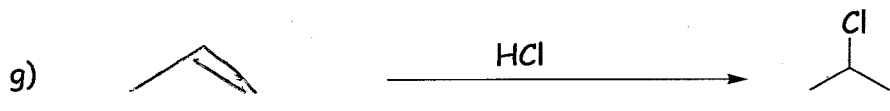
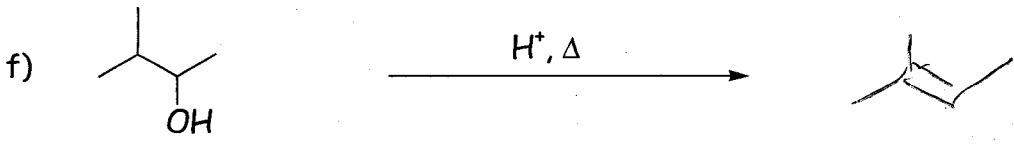


5. (10 points) Provide a mechanism for the following transformation, using proper electron-pushing formalisms.



6. (33 points) Each of the following transformations is missing either reactant(s), reagent(s), or product(s). Fill in the missing information so as to successfully complete the reaction. Remember that "NRX" is always a possible **PRODUCT**. Your best 11 of the 12 reactions given will be counted. Indicate stereochemistry where appropriate.





Extra Credit:

a) Who narrated "Rudolph, the Red-Nosed Reindeer"?

Burl Ives

B) What is the "name reaction" used in problem 7e?

SIMMONS-SMITH