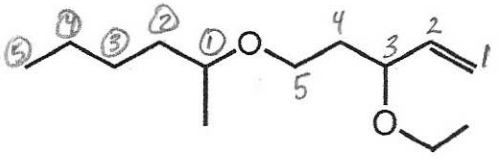
Exam 1, S '25

A. Nomenclature: (12 points)
Give an acceptable name for each of the following compounds. Be sure to indicate the **stereochemistry** where appropriate.

(-1) for incorrect numbering

1.

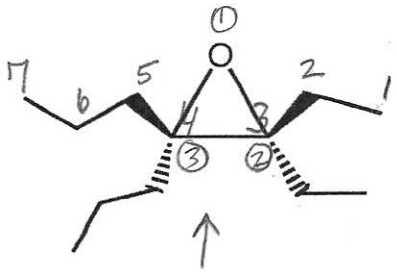


or

3-ethoxy-5-(1-methylpentoxy)-(1)-pentene

1 1 2

2.



cis or trans is incorrect!

2 1 1

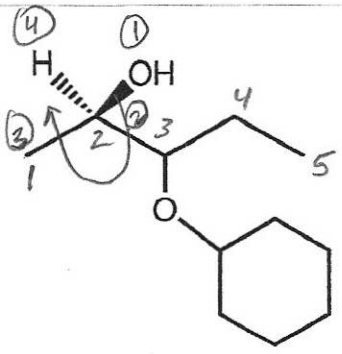
3,4-epoxy-3-ethyl-4-propylheptane

or

2,2-diethyl-3,3-dipropyloxirane

1 1 2

3.



(2R) ← okay, because C#3 is also chiral, but we can't determine.

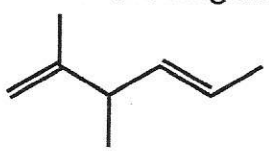
OR

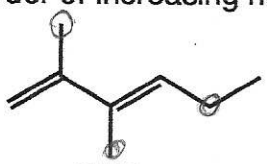
(R)-3-cyclohexoxy-(2)-pentanol

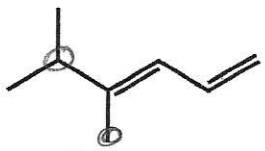
1 1 2

B. Facts: Total points = 20

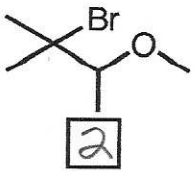
1. Rank the following alkenes in order of increasing heat of hydrogenation. (1=lowest, 3=highest) (3 pts.)

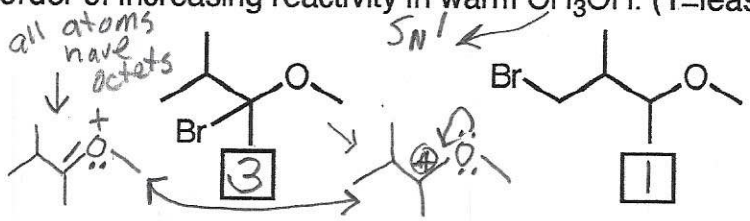




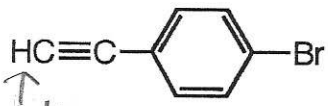


2. Rank the following compounds in order of increasing reactivity in warm CH_3OH. (1=least reactive, 3=most) (3 pts.)





3. If a compound below will produce a Grignard reagent in good yield, place Y in the box. If it will not, place N in the box. (3 pts)

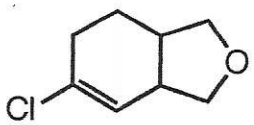


acidic H

N

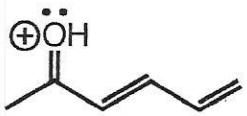
epoxide reacts

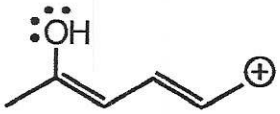
N

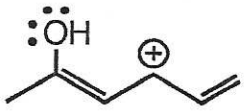


Y

4. a. Rank the following resonance structures in order of increasing importance to the hybrid. (1=least, 3=most) (3 pts.) b) What is the hybridization of the oxygen atom? (1 pt.)





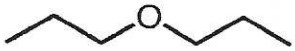


a) 3 | 1 | 2

b) sp^2

5. Rank the following compounds in order of increasing reactivity in HBr at 100°C. (1=least reactive, 3=most) (3 pts)

1

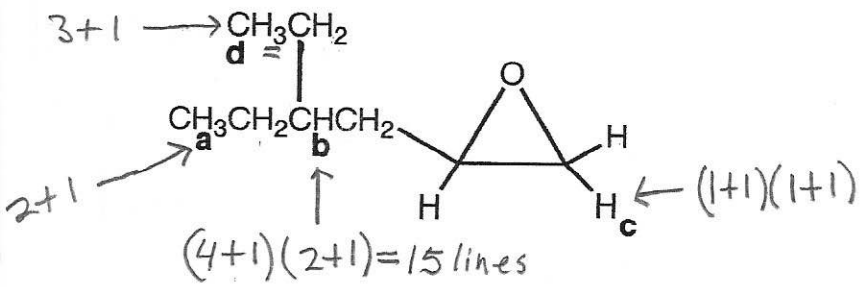


2

S_N2

3

6. Answer the following questions for the molecule below and place the answers in the appropriate boxes. (i) What is the theoretically predicited multiplicity of the signal for proton **a** in the ^1H NMR? (ii) What is the theoretically predicited multiplicity of the signal for proton **b**? (iii) What is the theoretically predicited multiplicity of the signal for proton **c**? (iv) What is the multiplicity of the signal for carbon **d** in the proton-coupled ^{13}C NMR? (4 pts.)



(i) multiplicity of Ha: t

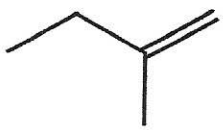
(ii) multiplicity of Hb: 15

(iii) multiplicity of Hc: dd or 4 lines

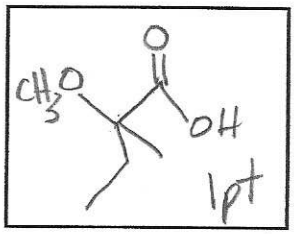
(iv) multiplicity of Cd: q (4)

C. Reactions: Total = 36 points, 6 points each
Please provide the major product in the answer box unless otherwise indicated. Indicate **stereochemistry** if applicable. **Full credit is awarded only when the product of each step in a multi-step reaction is shown below the reaction.**

1.

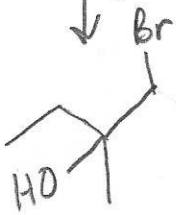


$1.Br_2 / H_2O$
2. NaOH
3. CH_3OH / H^+
4. $Na_2Cr_2O_7/H_2SO_4/H_2O$



1pt

1)



1pt

2)

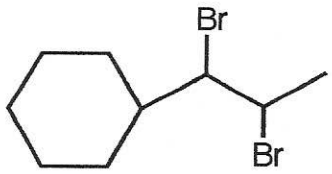
2pt

3)

2pt

4)

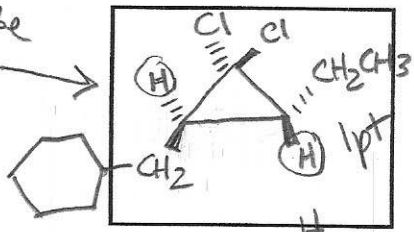
2.



1. $NaNH_2$, 150°C
2. CH_3CH_2Br

must be trans

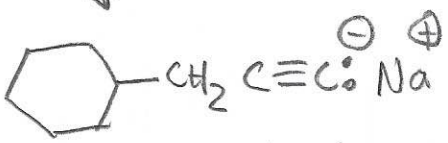
3. Li /NH_3
4. $CHCl_3$ / KOH



1pt

4)

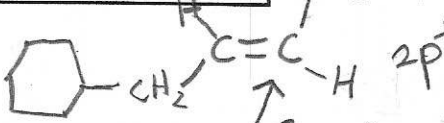
1)



2pt

2)

1pt

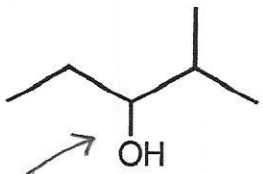


2pt

3

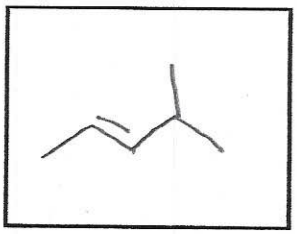
must be trans

3.



NO stereo shown here

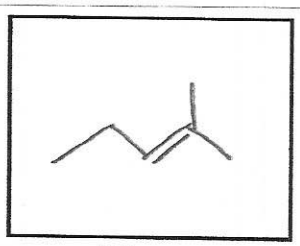
1. PBr_3
2. $CH_3)_3CO^-K^+/(CH_3)_3COH$



Major

2pt

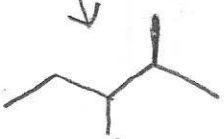
+



Minor

2pt

①

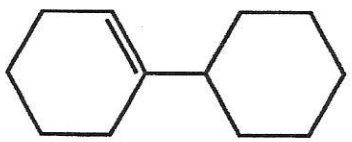


No stereo needed here

2pt

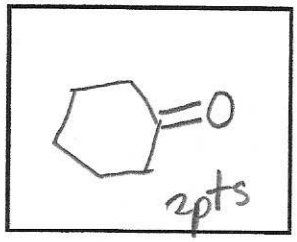
②

4.



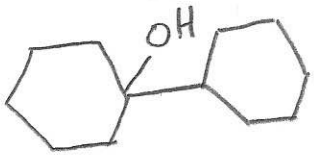
1. $Hg(OAc)_2$ / H_2O, then $NaBH_4$
2. H_2SO_4 / heat

3. O_3 , then $(CH_3)_2S$ or Zn/acetic acid



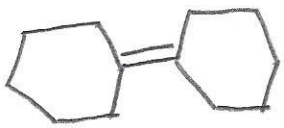
2pts

1)



2pts

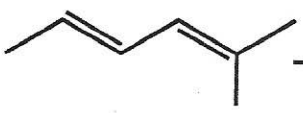
2)



2pts

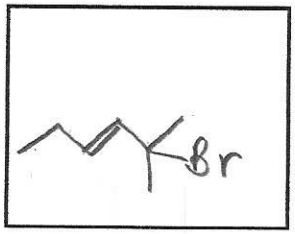
3)

5.



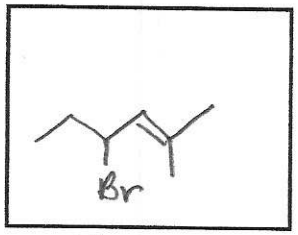
HBr

0°C

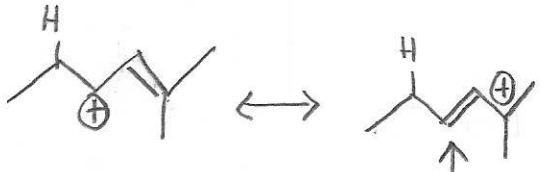


Major 3pts

+



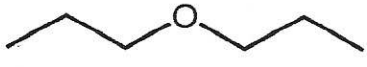
Minor 3pts



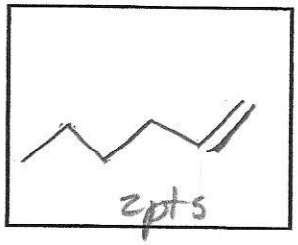
leads to more stable TS

(-3 if reversed)

6.



1. HBr (XS) / 100°C
2. Mg / ether
3. 



2pts

1)

2pts

2)

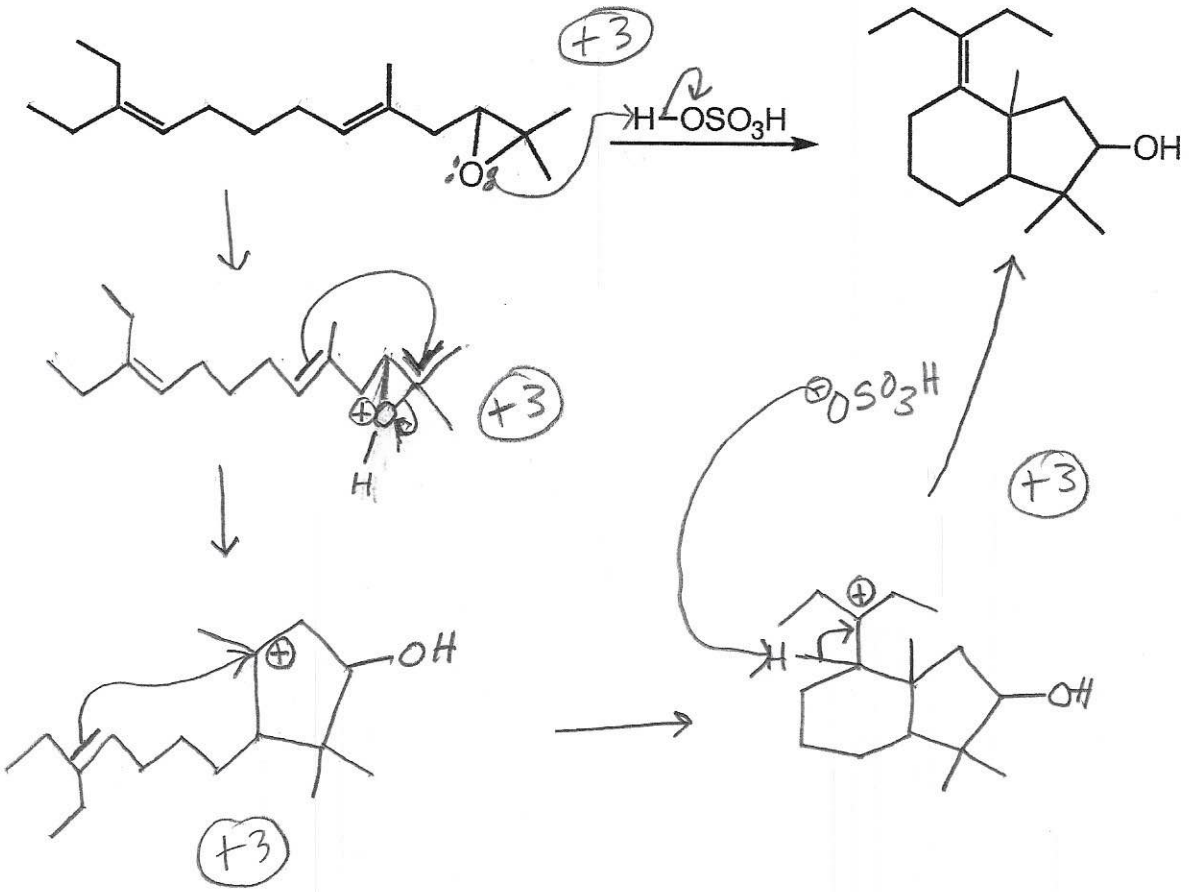
2pts

3)

see mechanism on Quiz 10
and the biosynthesis on p.8 of Ch.14 notes

D. Mechanism: (12 points)

Provide a clear mechanism to explain the formation of the product shown. Use curved arrows to indicate "electron flow". Remember to show only one step at a time. **Show all intermediates and all formal charges**. Please do not show transition states.

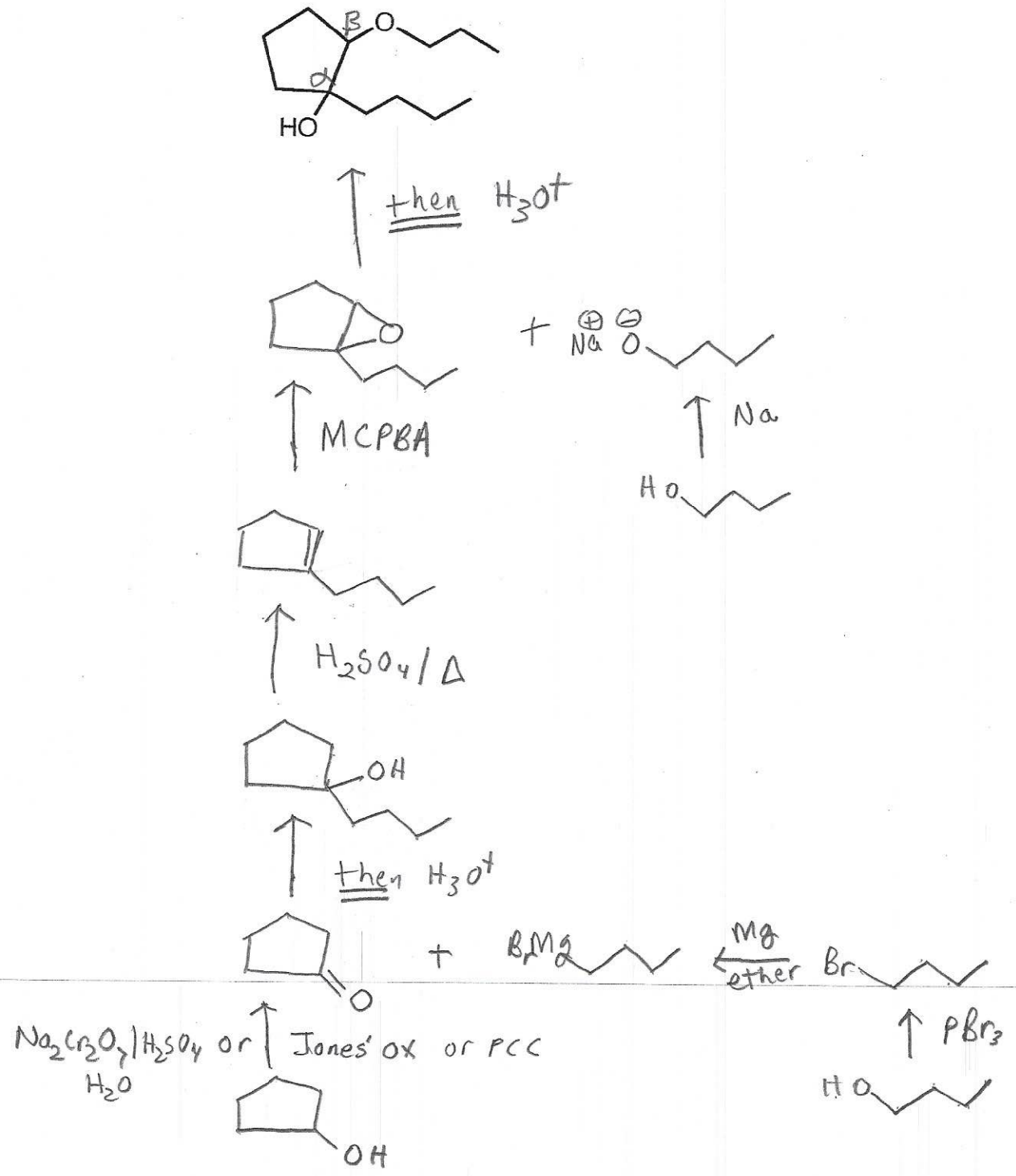


(-1) for missing arrows

(-1) for missing ⊕ (>2)

(A) see synthesis (6) on quiz 10

E. Synthesis: 10 Points
Synthesize the molecule below using any of the following reagents: cyclopentanol, any alcohols of **four carbons or less**, any inorganic reagents, any oxidizing or reducing agents, and any peroxyacids.

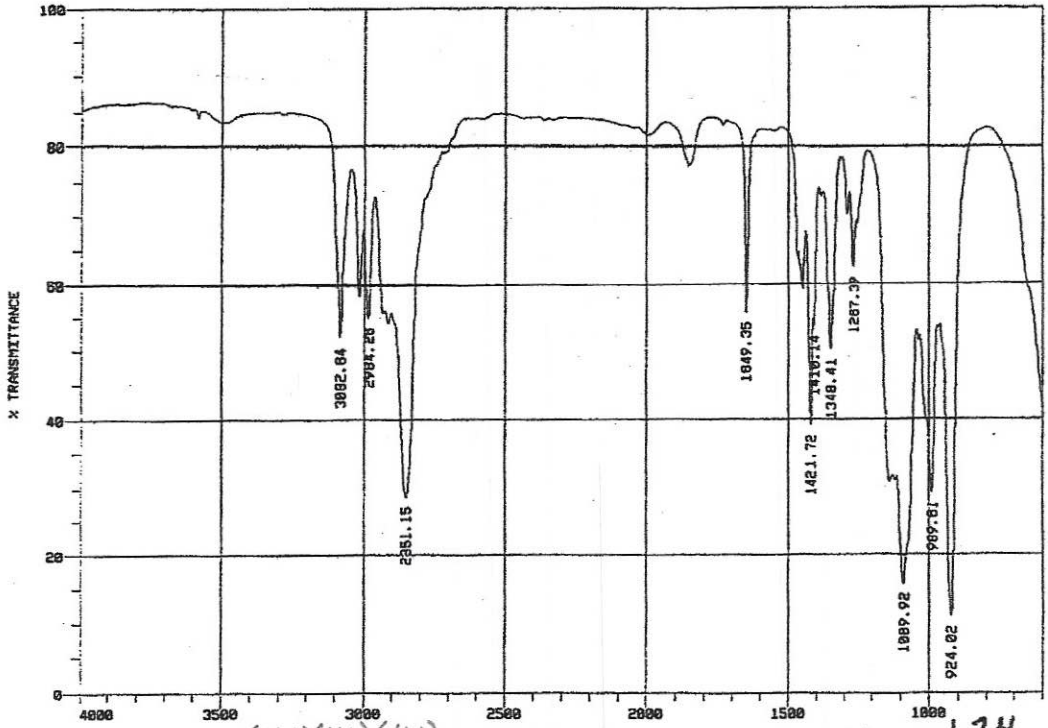


See alt. Exam 1 → also a terminal alkene

Spec. problem was

F. Spectroscopy: 10 Points

A compound with the formula $C_6H_{10}O$ exhibits the IR, ^1H NMR, and proton-spin decoupled ^{13}C NMR spectra shown below. Please identify this compound and draw the structure in the box provided below.

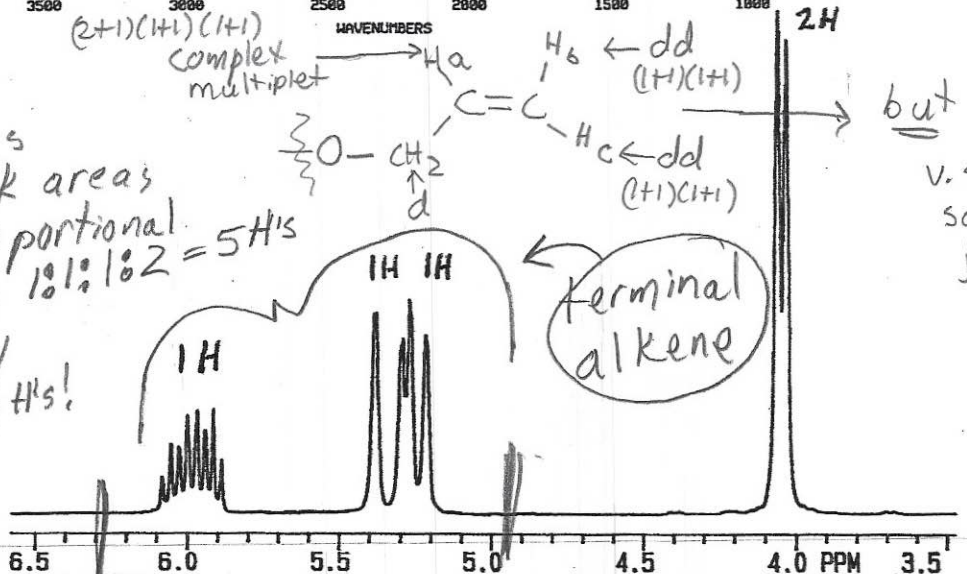


(2+1)(1+1)(1+1) complex multiplet → H_a

H_b ← dd (1+1)(1+1)

H_c ← dd (2+1)(1+1)

but J_{gem} is v. small (~1 Hz), so hard to see, just appears as doublet



terminal alkene

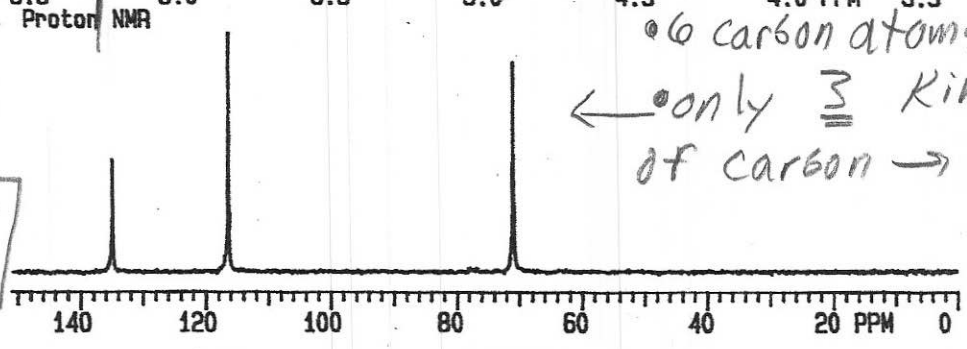
In ^1H NMR, instrument gives a ratio of peak areas

- peak area is proportional to # of H's ⇒ 1 : 1 : 1 : 2 = 5 H's

Must multiply by 2 to get 10 H's! ↓ symmetry in the ether

see the example at the end of the chapter 14 notes

- 6 carbon atoms in formula
- only 3 kinds of carbon → symmetry!



partial credit for wrong answers:

- any ether - +2
- terminal alkene +3
- other alkene +2
- CH_2 adj. to only 1H +2

$CH_2=CH-CH_2-O-CH_2CH=CH_2$