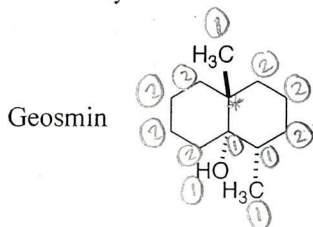
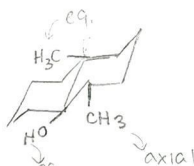


Final Exam
105 points total
Total time allowed= 110 minutes
 Note: Physical molecular modeling kits are allowed

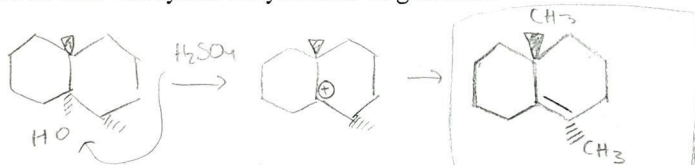
1. Geosmin is an organic compound made by bacteria! It is responsible for the smell of "wet earth" after it rains.



(a) Please write the most stable chair structure of geosmin with correct stereochemistry. (3 pts) 0



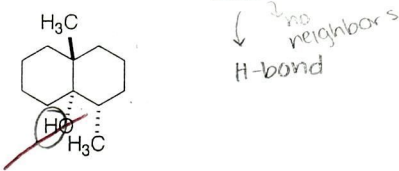
(b) Draw the major product of acid-catalyzed dehydration of geosmin. (3 pts) 3



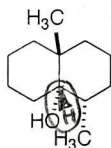
(c) How many distinct H chemical shifts would be expected for pure geosmin dissolved in CDCl₃ at room temperature? (3 pts) 1

19 *case!*

(d) Identify non-exchangeable hydrogens that may appear as a singlet in the ¹H NMR spectrum. (3 pts) 1

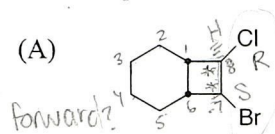


(e) Identify the most downfield shifted (deshielded) C atom in the ¹³C NMR spectrum of geosmin. (3 pts) 3

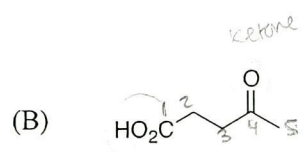


2. Please provide IUPAC nomenclature for the following compounds.

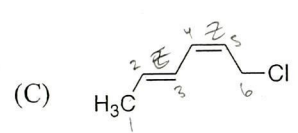
(8 points)



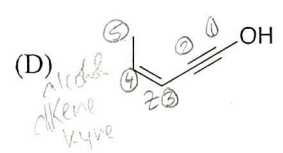
7-Bromo-8-chlorobicyclo[4.2.0]octane



4-oxopentanoic acid

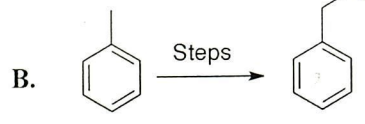
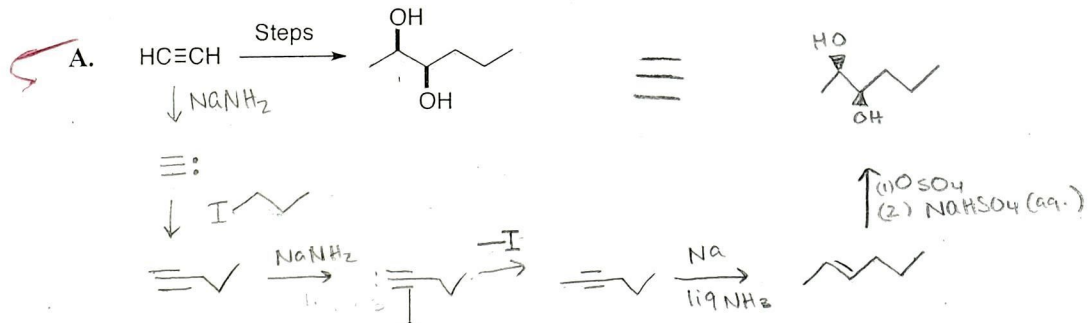


(2E,4Z)-6-chloro-2,4-hexadiene



(3Z)pent-4-en-1-yn-ol

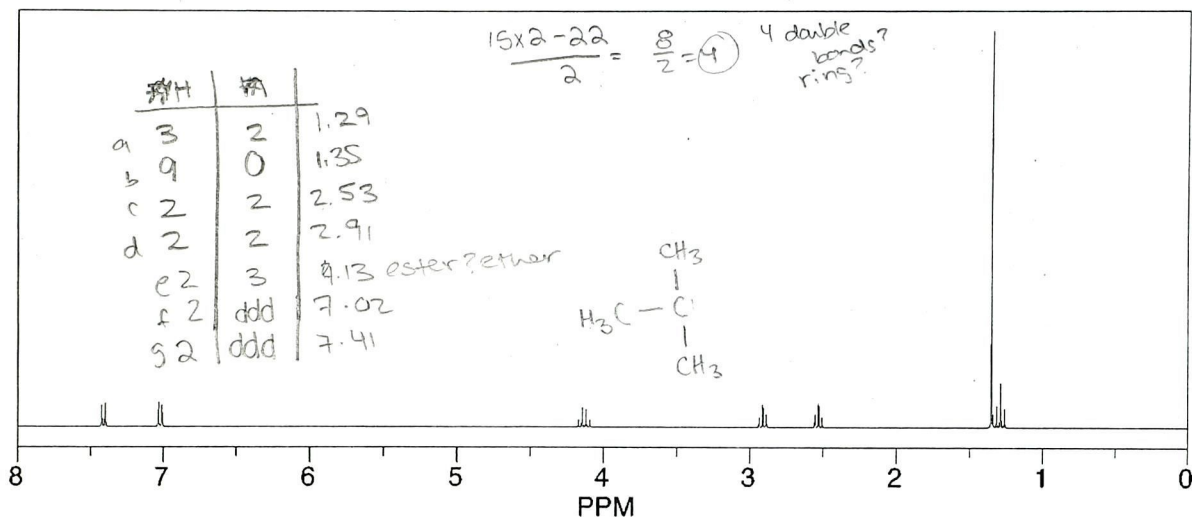
3. Please propose reasonable synthetic steps for ANY 5 of the following transformations. Please pay attention to the stereochemistry when choosing reagents for your synthesis. (25 points)



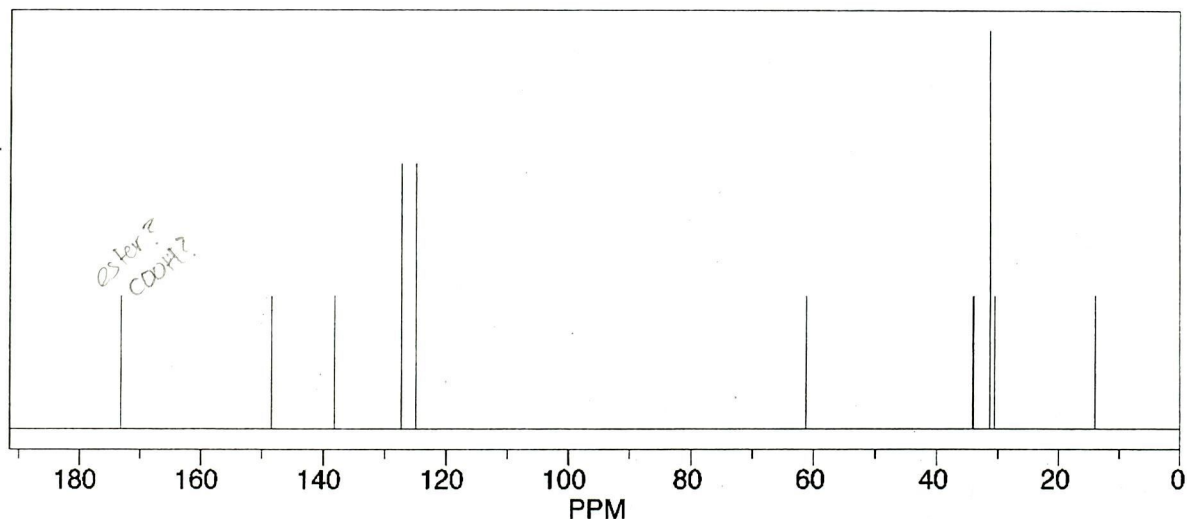
Name= _____

3. Based on the NMR data below, please indicate the structure of the compound with molecular formula $C_{15}H_{22}O_2$. (15 points)

There are partial points for identifying fragments of the correct compound. Hence, please write all your functional group assignments along with your final structure.



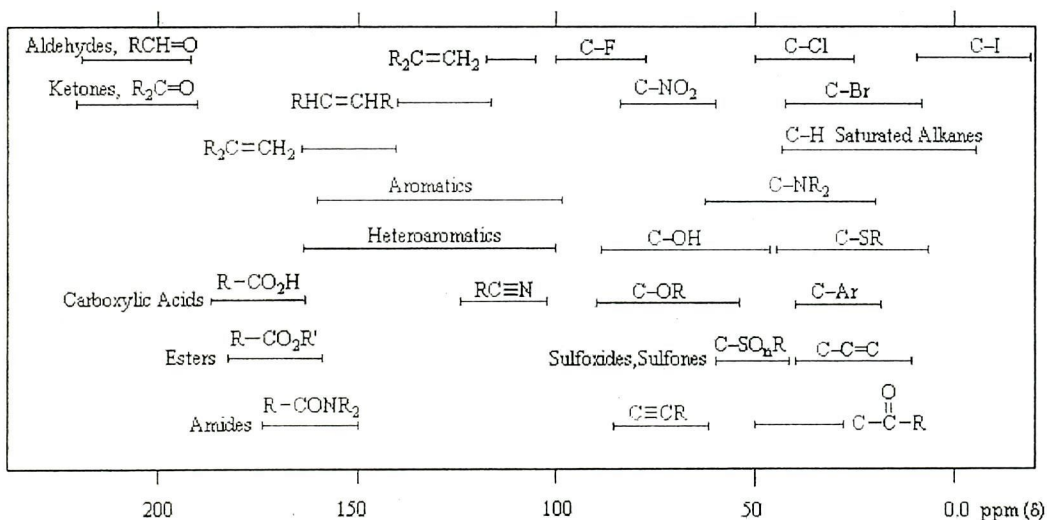
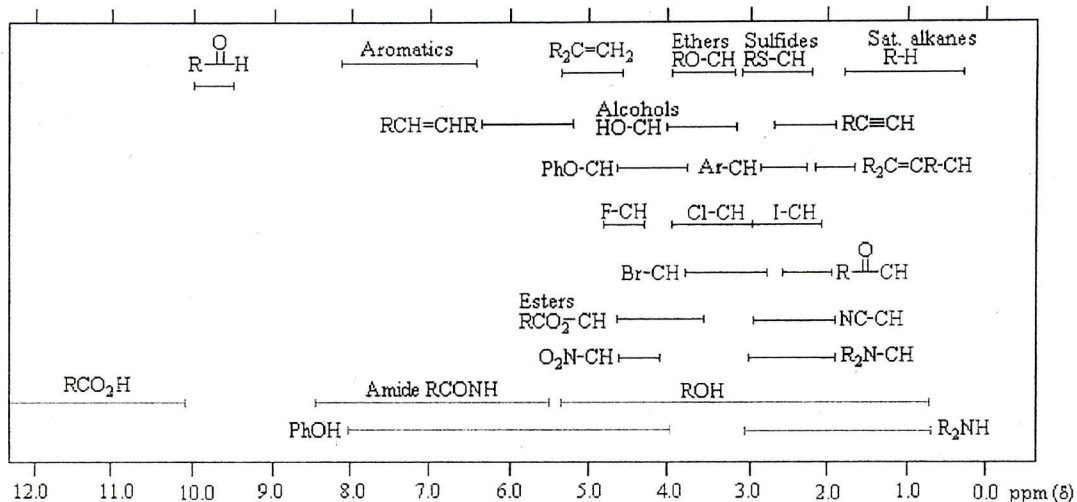
1H NMR: δ 1.29 (3H, triplet, $J = 7.1$ Hz), 1.35 (9H, singlet), 2.53 (2H, triplet, $J = 7.4$ Hz), 2.91 (2H, triplet, $J = 7.4$ Hz), 4.13 (2H, quartet, $J = 7.1$ Hz), 7.02 (2H, doublet of doublet of doublet, $J = 8.0, 1.0, 0.5$ Hz), 7.41 (2H, doublet of doublet of doublet, $J = 8.0, 1.4, 0.5$ Hz).



^{13}C NMR: δ 14.1 (1C), 30.5 (1C), 31.3 (3C), 34.1 (1C), 34.2 (1C), 61.3 (1C), 124.9 (2C), 127.3 (2C), 138.2 (1C), 148.5 (1C), 173.1 (1C).

Name= _____

For your reference here are the ranges of HNMR and CNMR spectra.



Points are divided as:

Identifying various functional groups ~5 points

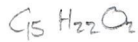
Correct relative placement of functional groups ~5 points

Correct final structure ~5 points

Please indicate your reasoning below:

Name= _____

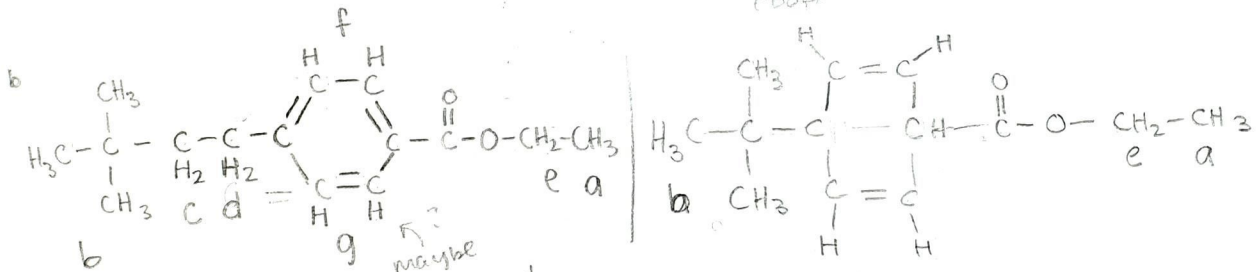
Reasoning (continued)



$$\frac{15 \times 2 + 2 - 22}{2} = 5 \text{ bonds deficient}$$

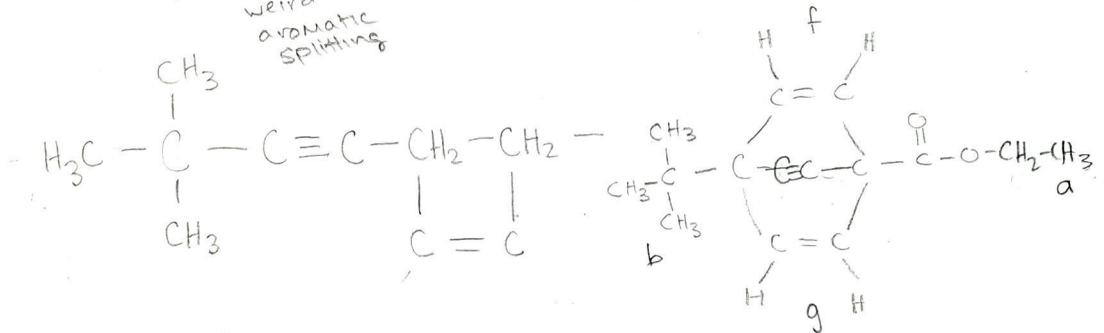
H		neighbors	
	H		
a	3	2	1.29
b	9	0	1.35
c	2	2	2.53
d	2	2	2.91
e	2	3	4.13 ester? ether
f	2	odd	7.02
g	2	odd	7.41 aromatic

^{13}C	
C	ppm
1	14.1
1	30.5
3	31.3
1	34.1
1	34.2
1	61.3 carb?
2	124.9
2	127.3
1	138.2
1	148.5 aromatic
1	173.1 ester? carb

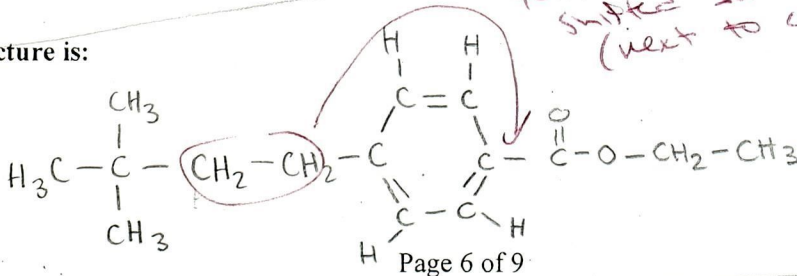


wtf?

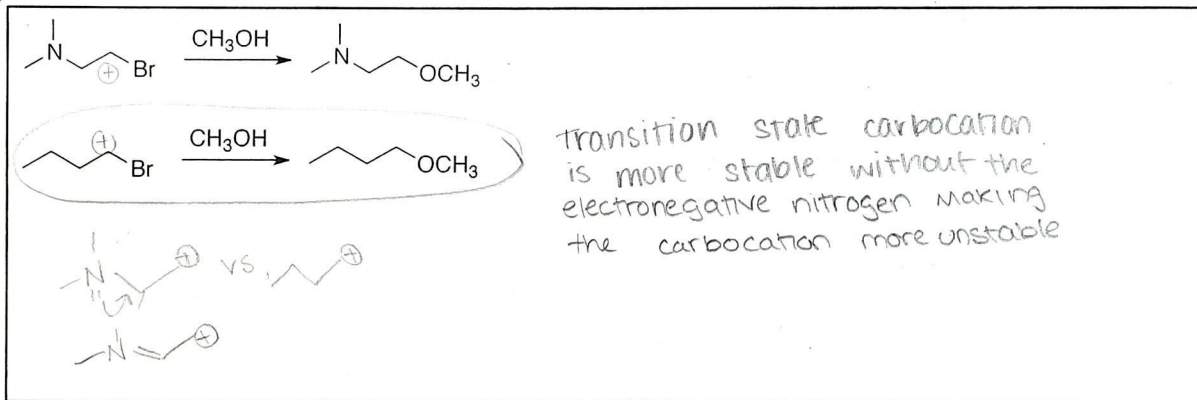
weird aromatic splitting



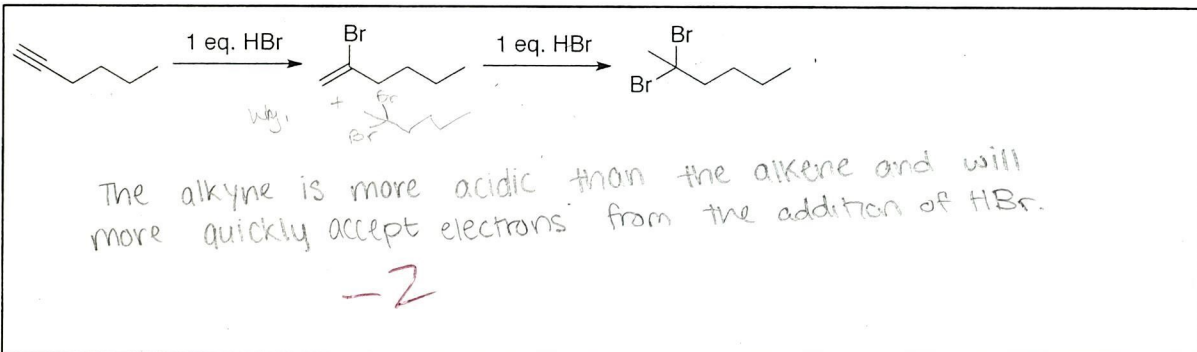
The final structure is:



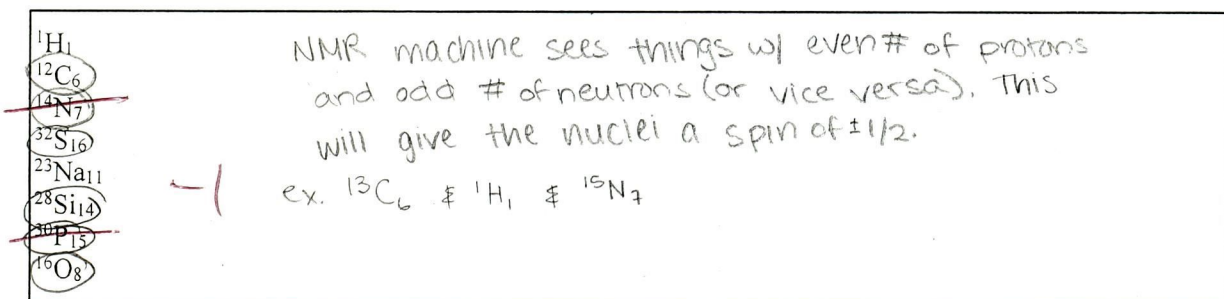
C. Which of the following solvolysis reactions would occur faster and why?



D. Why does the reaction shown below proceed in a stepwise manner without yielding a mixture of mono-brominated and dibrominated products with just 1 equivalent of HBr?



E. Circle the nuclei that cannot be observed in an NMR experiment, and please explain your rationale for why they are "invisible" in the NMR machine.



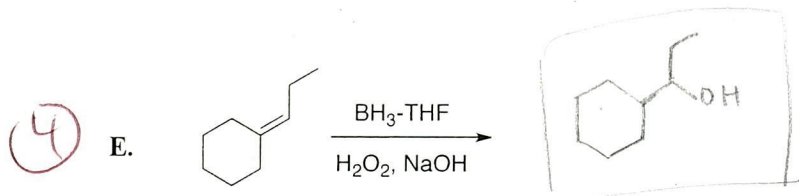
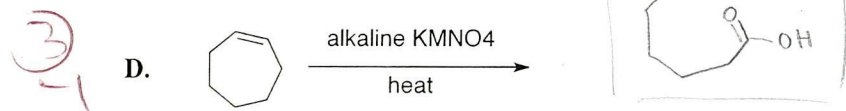
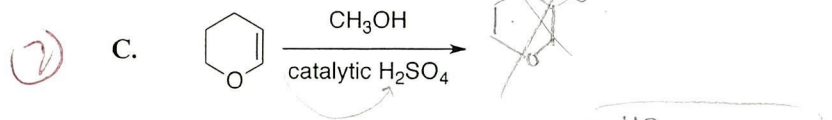
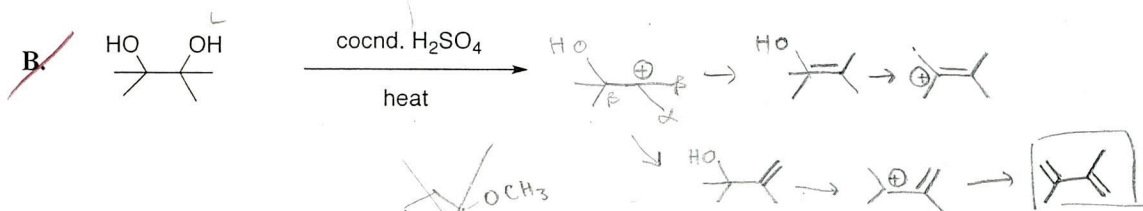
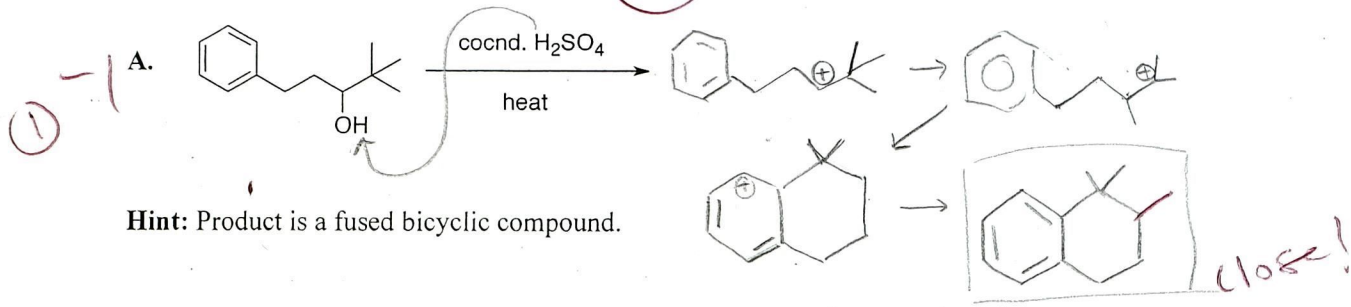
Bonus 2 points (answer any one).

Which of the nuclei above have integral spins? _____

Or,

Which 2D-NMR experiment is useful to determine the folded state of a protein? HETCOR

6. Please indicate the expected product(s) of ANY 4 of the following reactions. (12 points)



End of the exam