

Name: Answer Key

Last

First

MI

Chemistry 233 Exam 3

Fall 2017

Dr. J. Osbourn

Instructions: The first 8 questions of this exam should be answered on the provided Scantron. You must use a pencil for filling in the Scantron sheet. Ensure all erasures are complete. Any questions left blank will be marked incorrect. Answer the remaining questions on the exam itself. Show all work and provide complete explanations.

Please write your name on:

- The first page (Exam Cover Page)
- The second page (Grading Page)
- The Scantron Sheet – Circle your Last Name

Please bubble in your WVU Student ID Number on your Scantron sheet.

The Periodic Table

1 IA	2																				18 VIIIA	
1 H 1.01																						2 He 4.00
3 Li 6.94	4 Be 9.01																					
11 Na 22.99	12 Mg 24.31																					
19 K 39.1	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80					
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.9	54 Xe 131.29					
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)					
87 Fr (223)	88 Ra (226)	Ac^ (227)	Rf (261)	Db (262)	Sg (263)	Bh (264)	Hs (265)	Mt (268)	Ds (271)	Rg (272)												

*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
^	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Please do not rip off this cover sheet

Name: _____
Last First MI

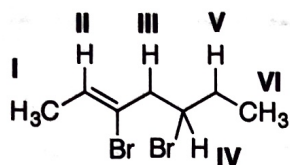
Grading Page (Exam 3):

Page	Points Possible	Points Earned
Multiple Choice (3-4)	16	
5	24	
6	27	
7	33	
TOTAL	100	

Multiple Choice

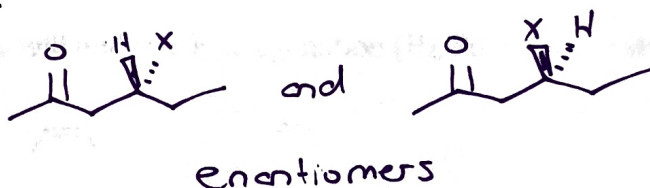
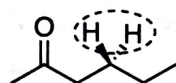
Choose the one best answer for each of the following questions. Using a pencil, record this answer on the provided Scantron sheet. (2 points each)

1. In the compound shown below, proton II is the most deshielded and VI is the most upfield.



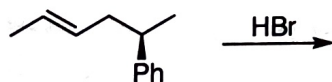
- IV, VI
- VI, II
- VI, III
- II, VI
- II, I

2. The two indicated protons are:

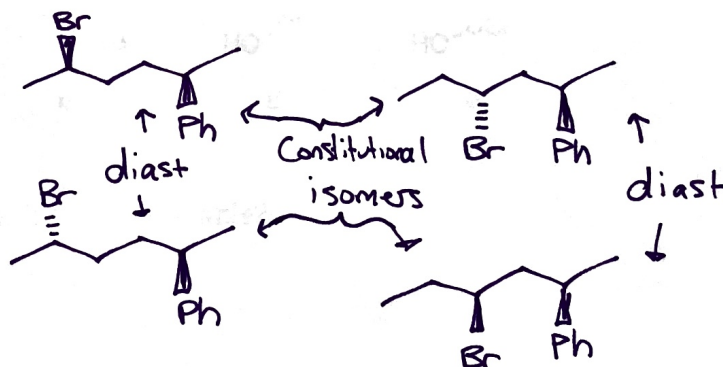


- Homotopic
- Heterotopic
- Enantiotopic
- Diastereotopic

3. The reaction shown below would produce how many and what kind of different products?



- 2 - a pair of enantiomers
- 2 - a pair of diastereomers
- 4 - two pairs of enantiomers
- 4 - four diastereomers
- None of the above

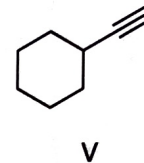
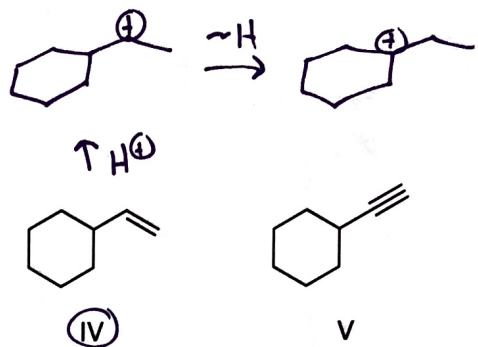
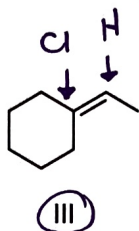
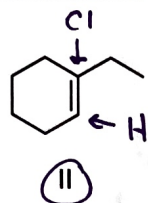
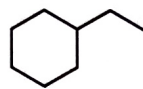
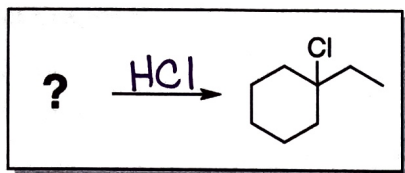


4. How many unsaturations are in a compound with the molecular formula $C_9H_{14}NOCl_3$?

- One
- Two
- Three
- Four
- Five

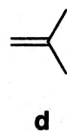
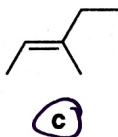
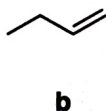
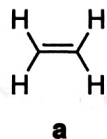
$$\frac{2(9) + 2 - 14 + 1 - 3}{2} = \frac{4}{2} = 2$$

5. What starting material could be used to carry out the following transformation?

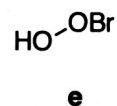
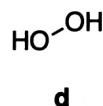
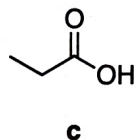
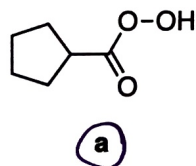


- a. I only
 b. II and III
 c. II, III, and IV
 d. II, III, IV, and V
 e. I and IV

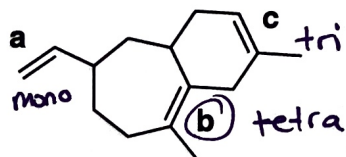
6. Which compound shown below will undergo hydrogenation (H_2 , Pd/C) at the **slowest** rate?



7. Which of the following is a peroxyacid?



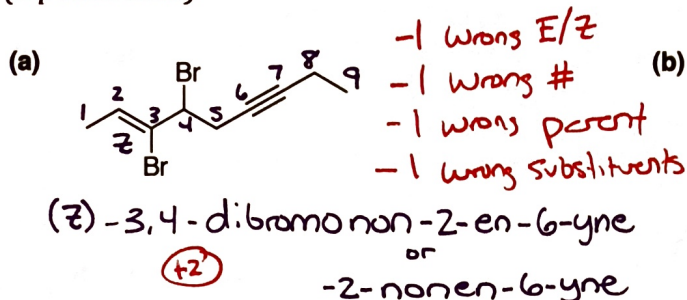
8. Which alkene in the molecule below is the most stable?



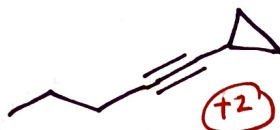
Completion Section

Answer the remaining questions in the spaces provided. Show all work and provide complete explanations.

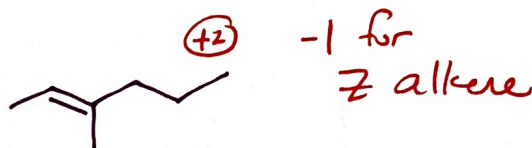
9. Provide IUPAC systematic name or draw the structure for each compound below. (2 points each)



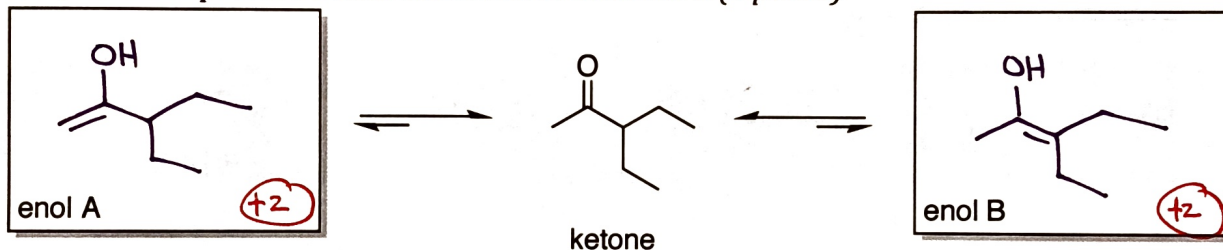
- (c) 1-cyclopropyl-1-pentyne



- (d) (E)-3-methyl-2-hexene

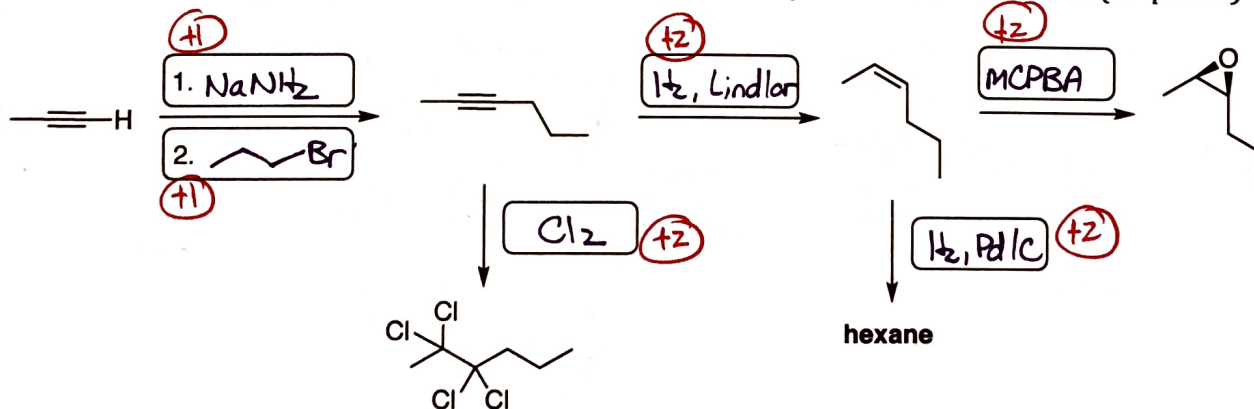


10. The ketone shown below can exist as two different enol tautomers. Draw the structure of each enol, and then provide a brief definition of tautomers. (6 points)

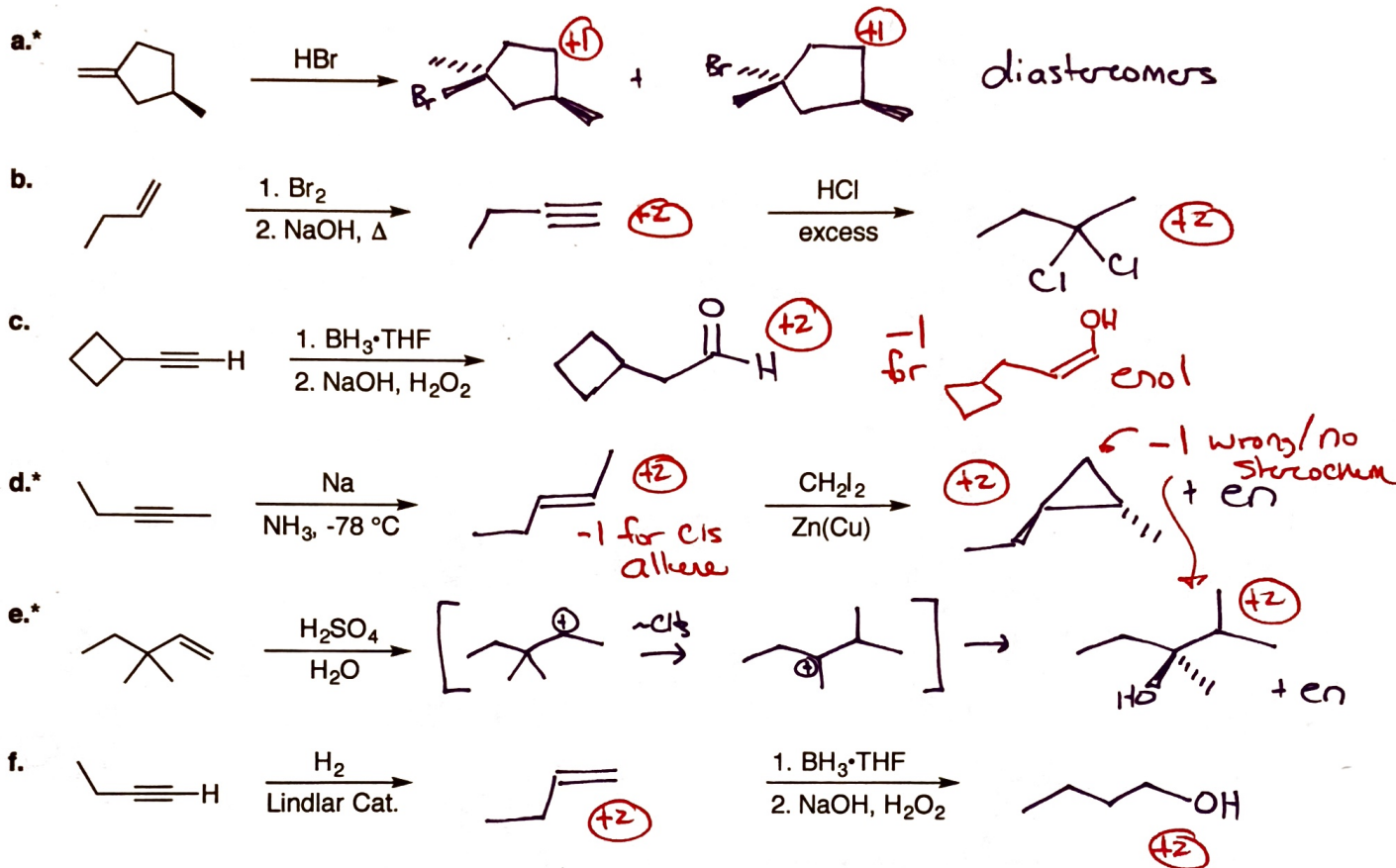


Tautomers: Constitutional isomers that exist in equilibrium
 +2

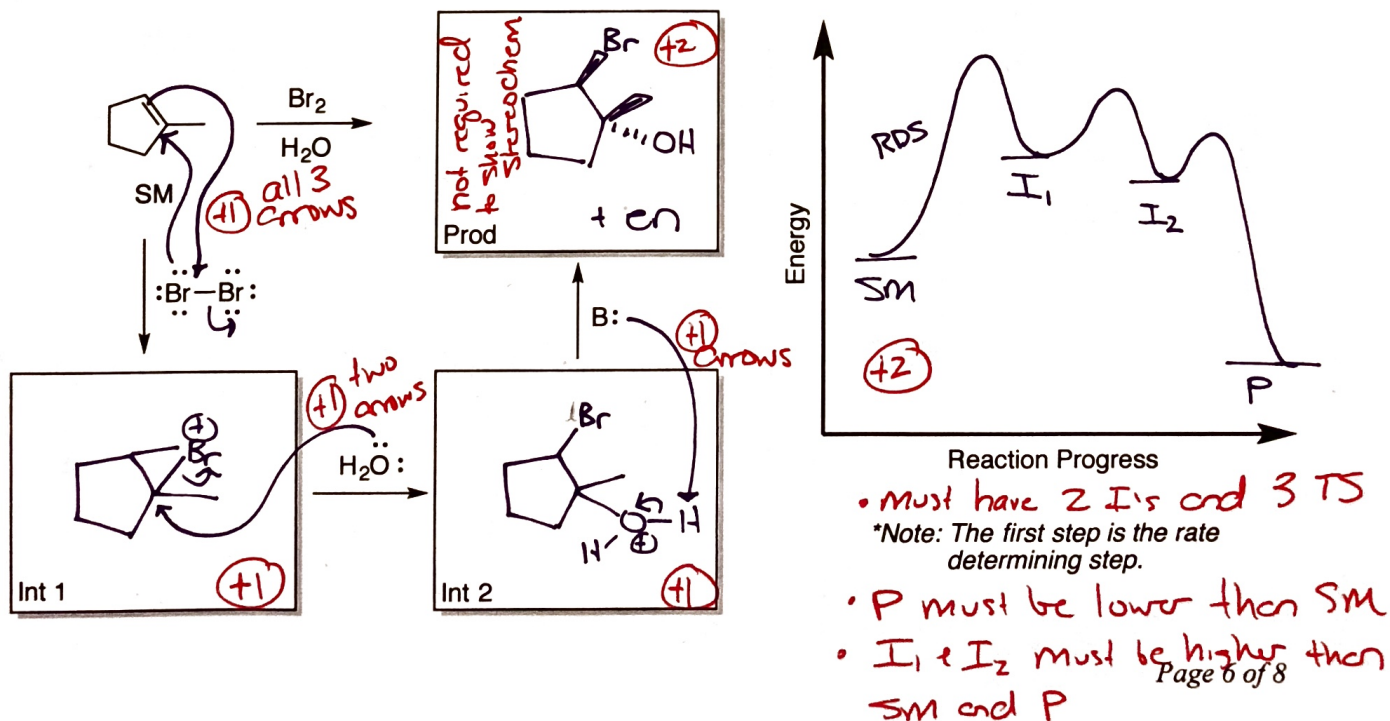
11. Provide the missing reagents necessary to accomplish the synthesis shown below. (10 points)



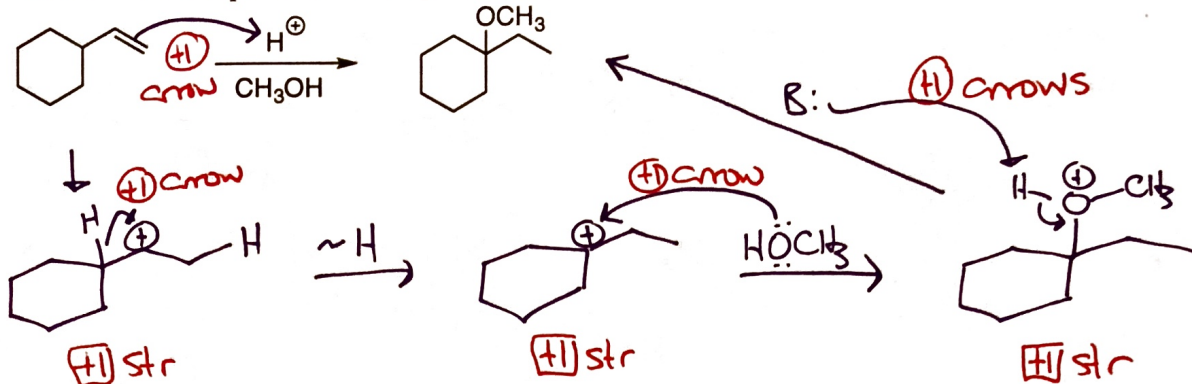
12. Predict the major organic product(s) for each reaction shown below. For reactions indicated with an asterisk (*), be sure to include stereochemistry. If the reaction produces a racemic mixture, you only need to draw one enantiomer. (2 points each)



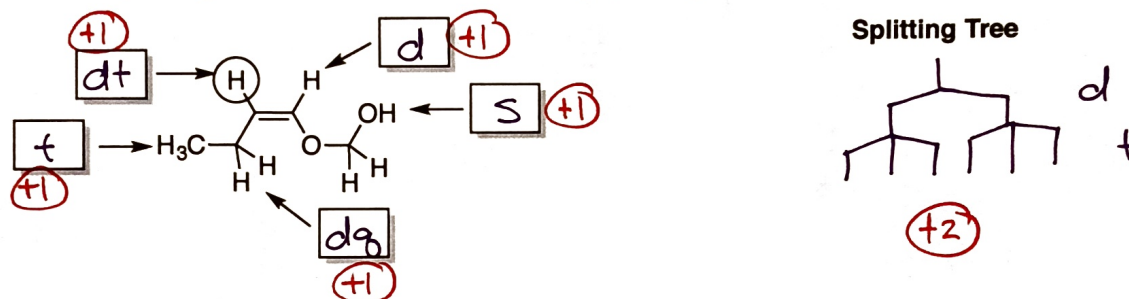
13. For the reaction below: a. Predict the product; b. Draw the intermediates; c. Draw in curved arrows to show electron flow in each step, and d. Complete the energy diagram (reaction coordinate). Label SM, Int 1, Int 2, and P in your energy diagram. (9 points)



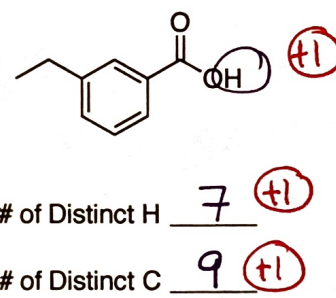
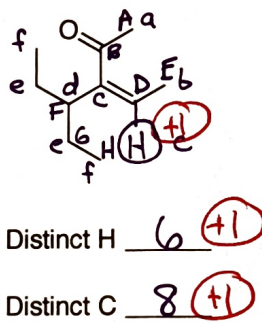
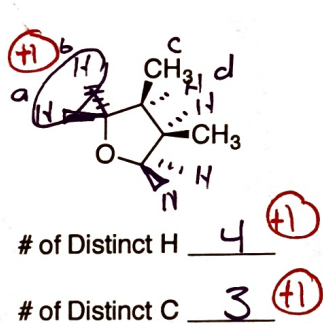
14. Provide the complete electron pushing mechanism for the reaction shown below. (7 points)



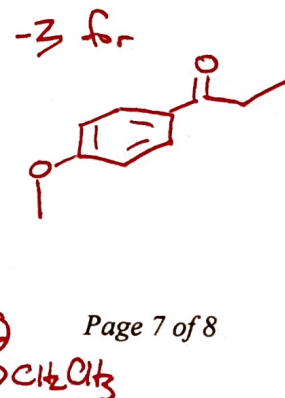
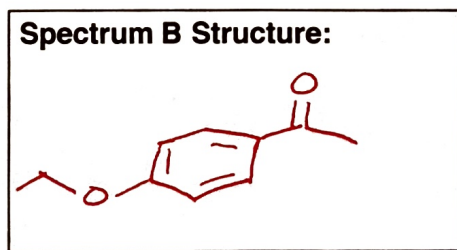
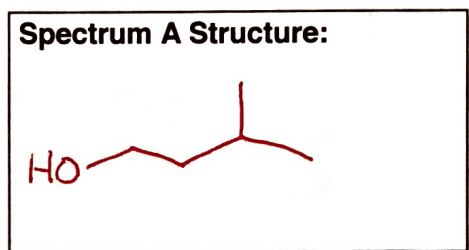
15. Predict the expected multiplicity (s, d, dd, etc.) for each proton in the molecule below. Then, draw a splitting tree for the circled proton. (7 points)



16. For each compound shown below: a. Determine the number of chemically distinct H; b. Determine the number of chemically distinct C; c. Circle the proton that would have the highest chemical shift (you may need to draw it in). (3 points each)



17. Draw the structure that corresponds to each ^1H NMR spectrum on page 8. (5 points each)



* Partial credit

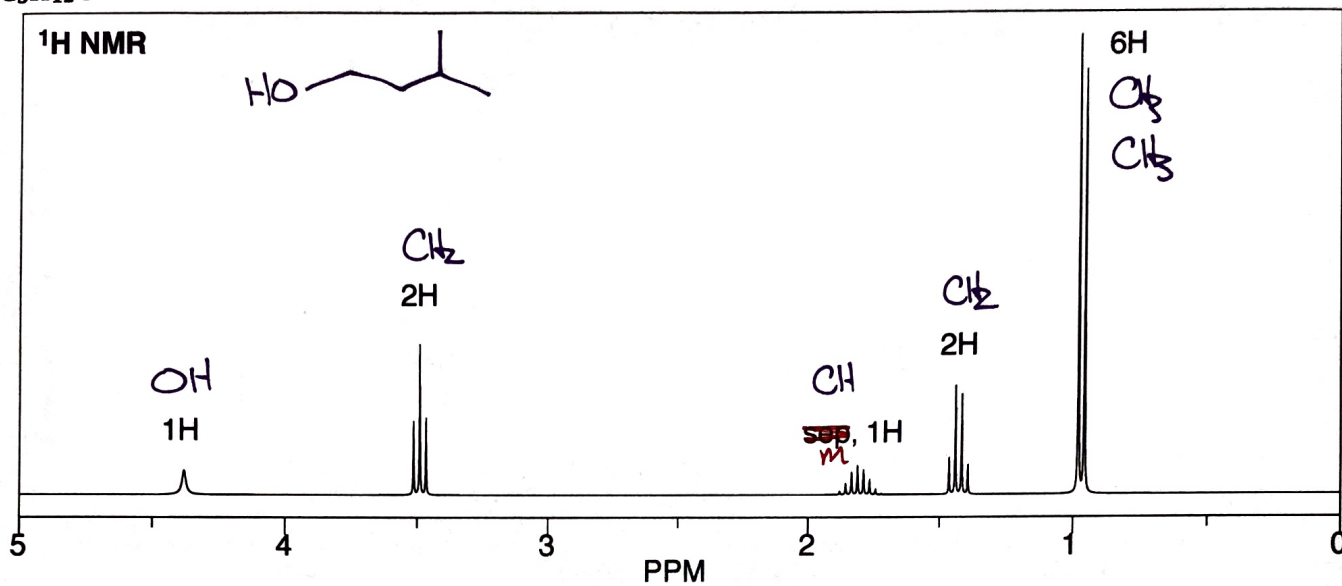
OH (+1) isopropyl (+1) $\text{CH}_2\text{-CH}_2$ fragment (+1)

Partial (+1) benzene

(+1) OCH_2CH_3 Page 7 of 8

Spectrum A:

$C_5H_{12}O$



Spectrum B:

$C_{10}H_{12}O_2$

