

Name: _____
 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																	18 VIIIA
1 H 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
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)	89 Ac^ (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

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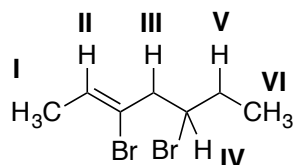
Grading Page (Exam 3):

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

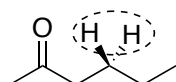
Multiple Choice

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)

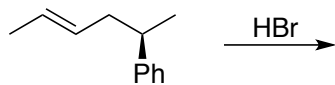
1. In the compound shown below, proton ____ is the most deshielded and ____ is the most upfield.



- a. IV, VI
 - b. VI, II
 - c. VI, III
 - d. II, VI
 - e. II, I
2. The two indicated protons are:

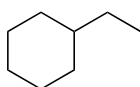
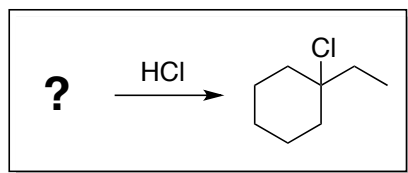


- a. Homotopic
 - b. Heterotopic
 - c. Enantiotopic
 - d. Diastereotopic
3. The reaction shown below would produce how many and what kind of different products?

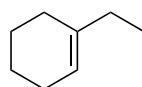


- a. 2 – a pair of enantiomers
 - b. 2 – a pair of diastereomers
 - c. 4 – two pairs of enantiomers
 - d. 3 – a pair of diastereomers and a constitutional isomer
 - e. 4 – two different pairs of diastereomers
4. How many unsaturations are in a compound with the molecular formula **C₉H₁₄NOCl₃**?
- a. One
 - b. Two
 - c. Three
 - d. Four
 - e. Five

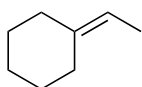
5. What starting material(s) could be used to carry out the following transformation?



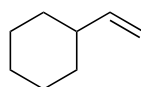
I



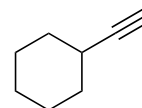
II



III



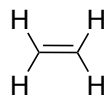
IV



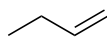
V

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

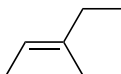
6. Which compound shown below will undergo hydrogenation (H_2 , Pd/C) at the **slowest** rate?



a



b

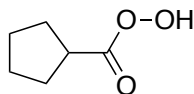


c



d

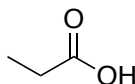
7. Which of the following is a peroxyacid?



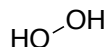
a



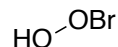
b



c

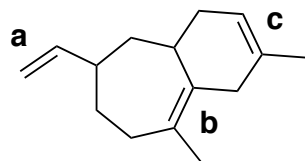


d



e

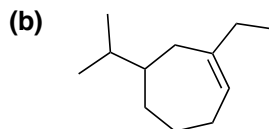
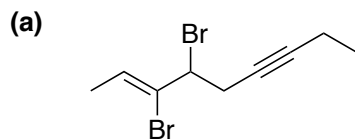
8. Which alkene in the molecule below is the most stable?



Completion Section

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

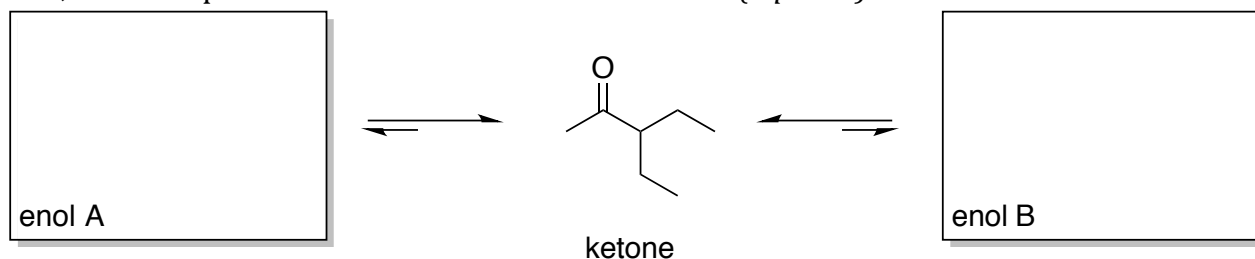
9. Provide IUPAC systematic name or draw the structure for each compound below. (2 points each)



(c) 1-cyclopropyl-1-pentyne

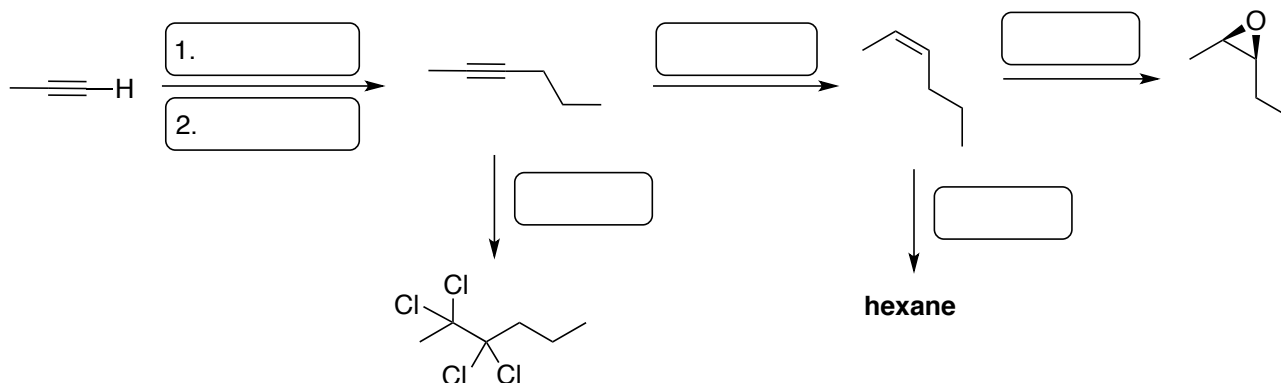
(d) (E)-3-methyl-2-hexene

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)



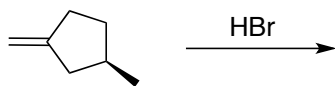
Tautomers: _____

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)

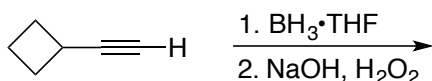
a.*



b.



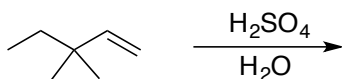
c.



d.*



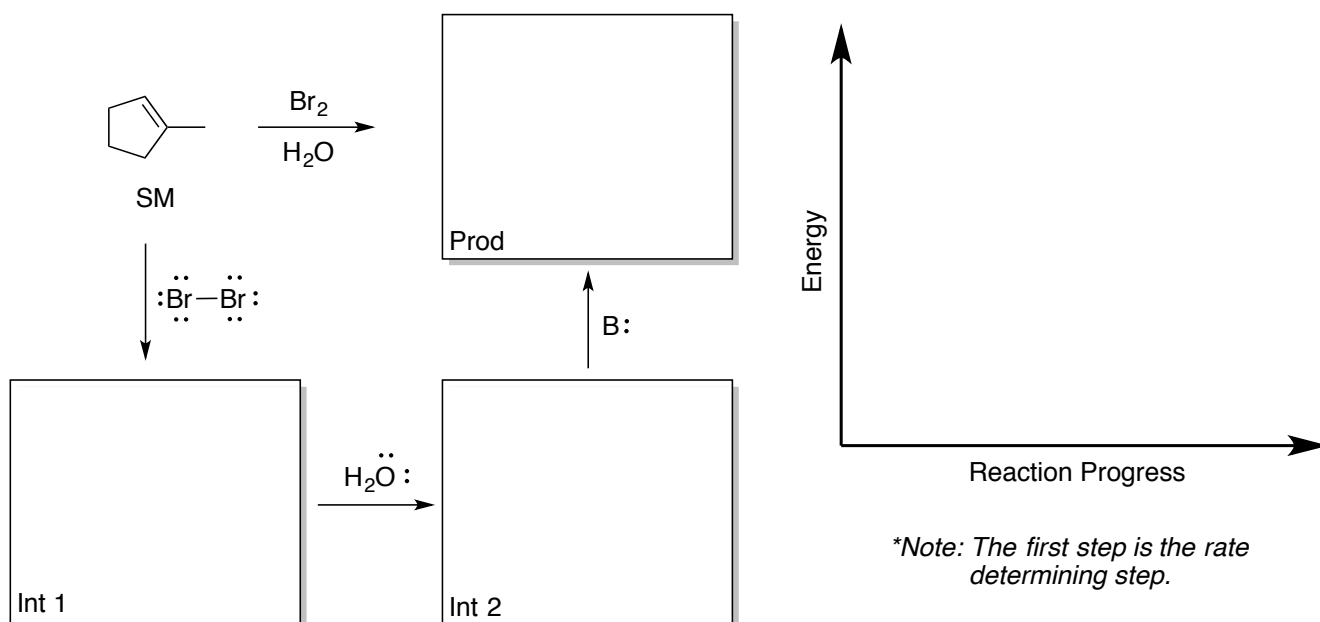
e.*



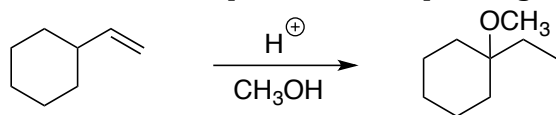
f.



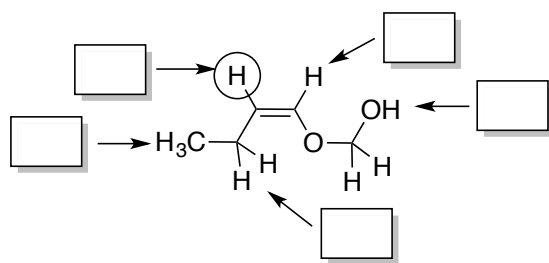
13. For the reaction below: **a.** Predict the product; **b.** Draw the intermediates; **c.** Draw in curved arrows to show electron flow in each step, and **d.** Complete the energy diagram (reaction coordinate). Label SM, Int 1, Int 2, and P in your energy diagram. (9 points)



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

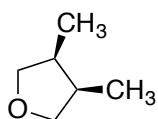


15. Predict the expected multiplicity (s, d, dd, etc.) for each proton in the molecule below. Then, draw a splitting tree for the circled proton. (7 points)



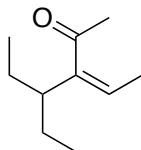
Splitting Tree

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)



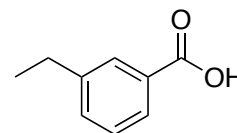
of Distinct H _____

of Distinct C _____



of Distinct H _____

of Distinct C _____



of Distinct H _____

of Distinct C _____

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

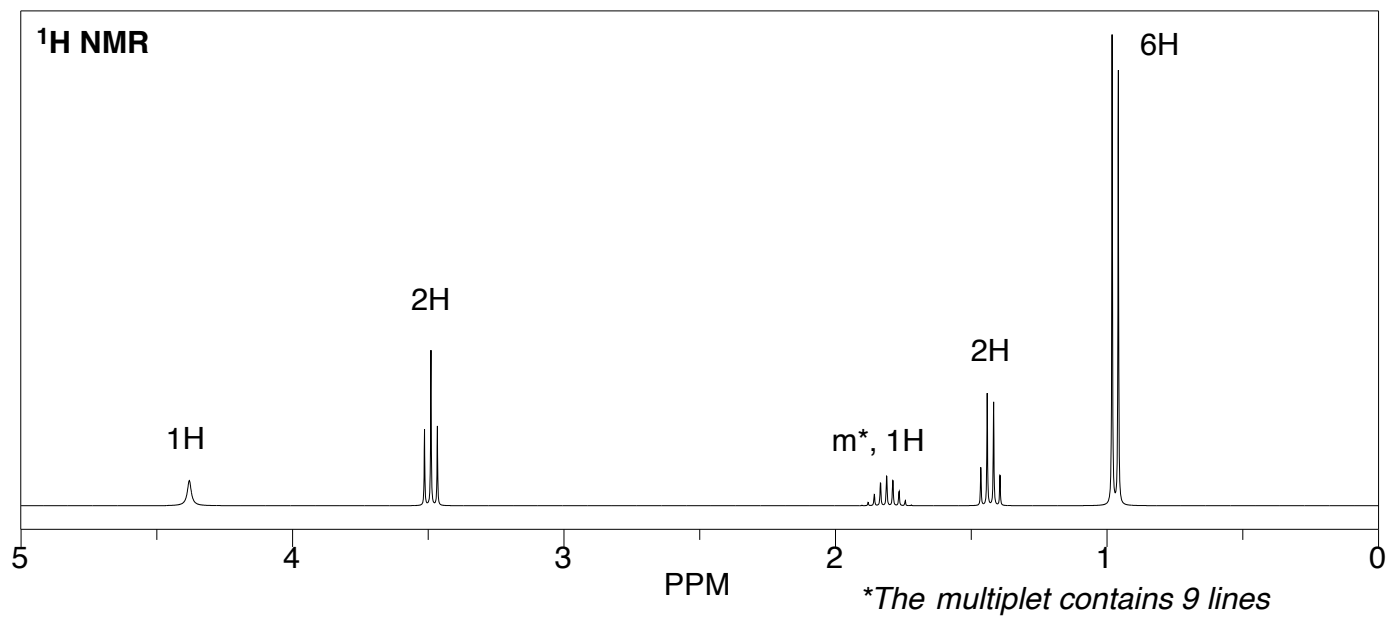
Spectrum A Structure:

Spectrum B Structure:

Spectrum A:

$C_5H_{12}O$

Unsaturation = ____



Spectrum B:

$C_{10}H_{12}O_2$

Unsaturation = ____

