

LAST NAME:

FIRST NAME:

COVER PAGE

Instructions

This exam will be closed book. No notes, books, calculators, or molecular models will be allowed. The exam will be comprised of two distinct parts: **Part I** will consist of a series of multiple choice questions. Your answers to these questions must be submitted on a Scantron “bubble” sheet. The answer sheet will be provided for you, but you will need your own #2 pencil(s). Only answers marked on the bubble sheet will be graded. Answers to Part I questions marked on the exam itself cannot not be graded. No re-grades will be possible on Part I of the exam.

Part II consists of questions for which you will need to write out your answers, using structures and/or words. This part of the exam will be hand-graded. Answers for the Part II questions that are written in pencil will not be eligible for re-grades. Answers written in pencil with ink overlay will not be eligible for re-grades. If you use a pen to answer the Part II questions, only blue or black ink is acceptable. Answers written in red ink cannot be graded.

1. You must have your valid UT ID card (or other government-issued ID) with you. You will need to show it to the proctors when you turn in your exam.
2. Chapter 4 of the University’s “General Information” catalog outlines this university’s policies regarding exams, as well as other quizzes administered during the semester. Specifically, students are expected to remain in the exam room until a test is completed. These policies will be strictly enforced, with no exceptions. You may not leave the room for any reason until you are ready to turn in your exam. If you wish to leave the room, you will need to turn in your exam to the proctors, and you will not be allowed to return. Please, plan accordingly by using the rest room before the exam starts.

CH 310 N EXAM I

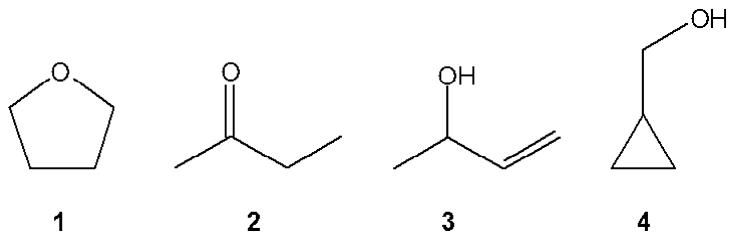
Question	Value	Score
1	20	
2	15	
3	10	
4	10	
5	10	
6	10	
Section II	75	
Section I	75	
Raw Total	150	
Grade		

CH310N-Exam I

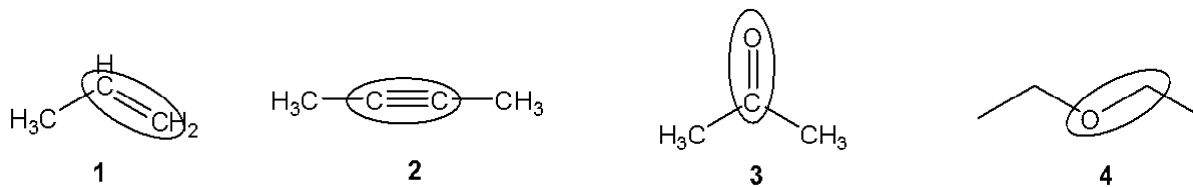
Objective Test Section

Identify the choice that best completes the statement or answers the question. There is only one correct answer; please carefully bubble your choice on the scantron sheet. (3pts. ea; 75 pts this section)

1. Which of the following compounds gives an infrared spectrum with peaks in the ranges of 3200-3650 (strong, broad), but does not have peaks at 1630-1820 (strong) or 1600-1640 cm^{-1} (medium)?

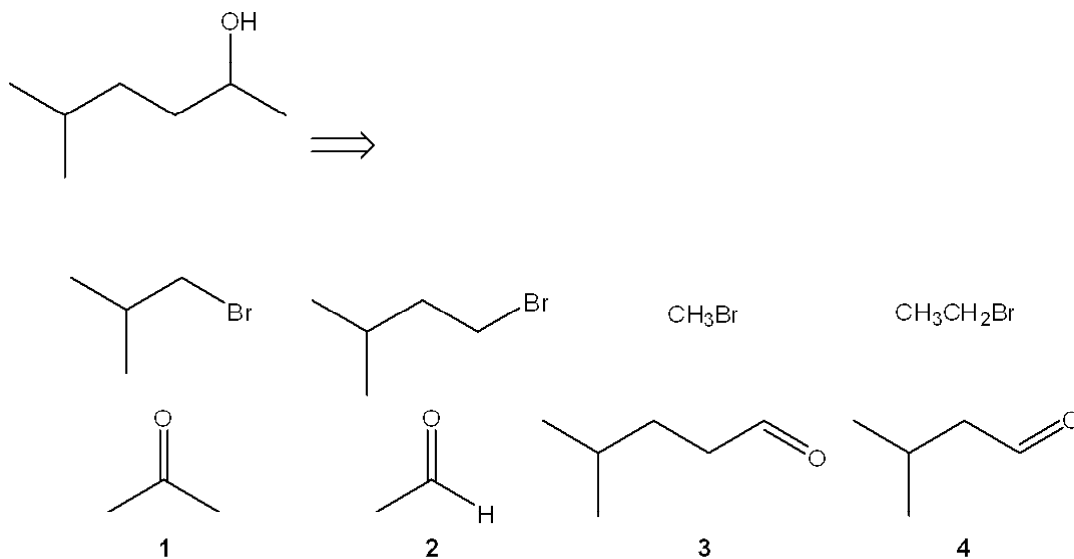


- a. 1
b. 2
c. 3
d. 4
2. Which feature in the ^1H NMR spectrum provides information about the relative number of each type of proton in a compound?
- a. chemical shift
b. number of signals
c. integral
d. splitting
3. Which of the following bonds (circled) gives the weakest absorbance in the infrared spectrum?



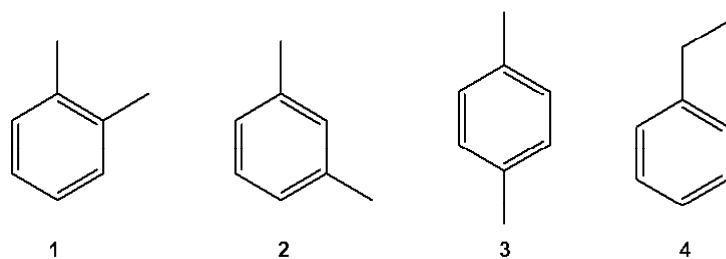
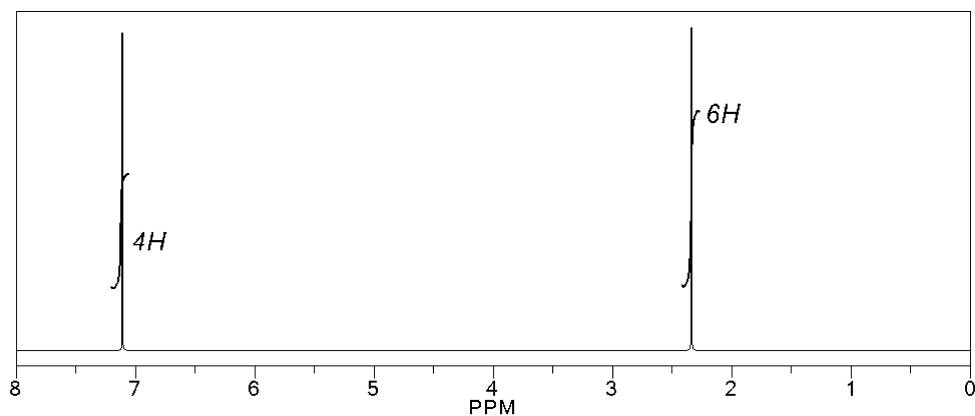
- a. 1
b. 2
c. 3
d. 4
4. Which of the following compounds is the strongest base?
- a. $\text{CH}_3\text{CH}_2\text{OMgBr}$
b. $\text{CH}_3\text{CH}_2\text{MgBr}$
c. CH_3CH_3
d. $\text{CH}_3\text{CH}_2\text{OH}$

5. Which of the following combinations of peaks appears in the ^1H NMR spectrum of diethyl ether, $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$?
- a quartet and a sextet
 - two singlets
 - a triplet and a doublet
 - a triplet and a quartet
6. What is the hydrogen deficiency index for a compound with a molecular formula of $\text{C}_{10}\text{H}_{16}\text{O}_2$?
- 1
 - 2
 - 3
 - 4
7. Which feature in the ^1H NMR spectrum provides information about the number of types of different protons in a compound?
- chemical shift
 - integral
 - number of signals
 - splitting
8. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?



- only **1**
 - only **3**
 - only **1** and **4**
 - only **2** and **3**
9. How many sets of equivalent protons are there in 3-methylhexane?
- 3
 - 2
 - 6
 - 7

10. Which C_8H_{10} compound gives the following 1H NMR spectrum?

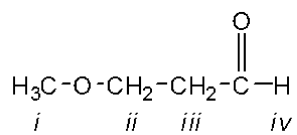


- a. **1**
- b. **2**
- c. **3**
- d. **4**

11. How many sets of equivalent protons are there in n-hexane?

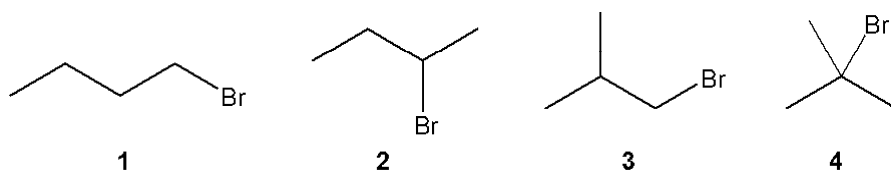
- a. 7
- b. 3
- c. 2
- d. 6

12. Which of the protons in the following molecule appear furthest **downfield** in the 1H NMR spectrum?

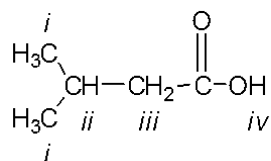


- a. *i*
- b. *ii*
- c. *iii*
- d. *iv*

13. Which of the following relationships is **not** valid as applied to infrared spectroscopy?
- $\nu = 4.12 \sqrt{K/\mu}$
 - wavenumber = $1/\lambda$ (in cm)
 - $\Delta E = \lambda \nu$
 - $\Delta E = Bo$
14. Which of the following is **not** true regarding ^1H NMR spectroscopy?
- on a 300 MHz instrument, a proton that adsorbs irradiation at a frequency 1200 Hz higher than the adsorption of TMS appears at δ 4 ppm.
 - a "downfield" peak appears at a higher value of δ
 - "shielding" leads to peaks at lower values of δ
 - δ for a particular proton depends on the magnetic field strength of the instrument used.
15. Which $\text{C}_4\text{H}_9\text{Br}$ compound gives a doublet at approximately 3.3 ppm in the ^1H NMR spectrum?

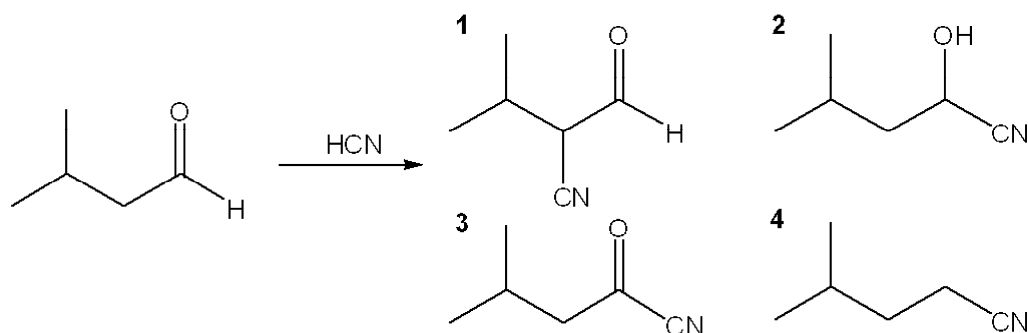


- 1
 - 2
 - 3
 - 4
16. Which of the protons in the following molecule appear at the **highest δ -value** in the ^1H NMR spectrum?



- i*
 - ii*
 - iii*
 - iv*
17. What is required for a bond to give an infrared absorption?
- a change in bond dipole during vibration
 - a change in bond angle during vibration
 - a change in bond length during vibration
 - a change in reduced mass during vibration

18. What is the major organic product obtained from the following reaction?



- 1
- 2
- 3
- 4

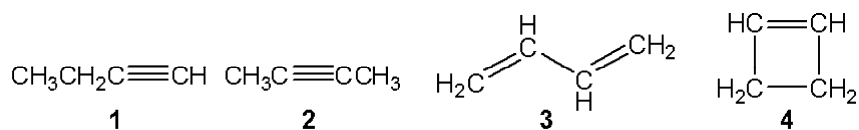
19. Which of the following bonds gives rise to a strong, broad, absorbance at approximately $3200\text{--}3650\text{ cm}^{-1}$ in the infrared spectrum?

- C=C
- C=O
- O-H
- C-H

20. What is the splitting of the signal in the ^1H NMR spectrum for the methyl protons of **ethane**?

- singlet
- quartet
- triplet
- doublet

21. Which of the following compounds gives an infrared spectrum with peaks at 3300 cm^{-1} (sharp peak) and 2150 cm^{-1} (sharp peak)?

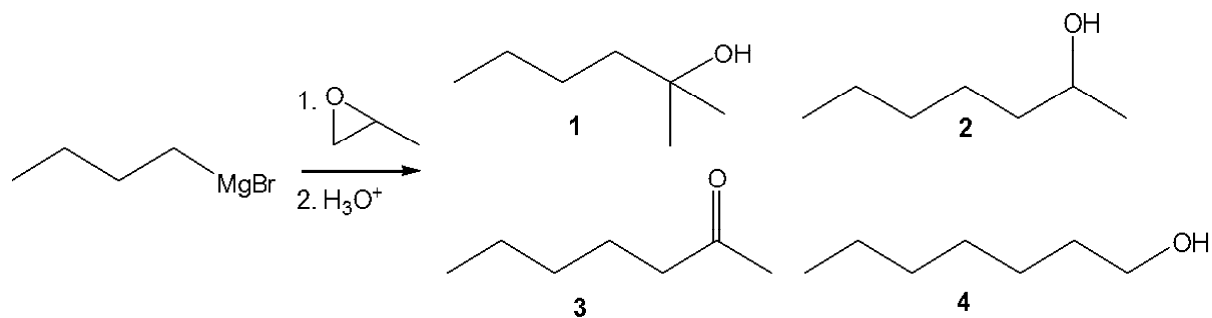


- 1
- 2
- 3
- 4

22. What is the hydrogen deficiency index for a compound with a molecular formula of $\text{C}_6\text{H}_6\text{Br}_2$?

- 1
- 2
- 3
- 4

23. What is the major organic product obtained from the following reaction?

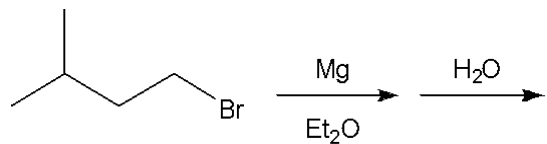


- a. **1**
- b. **2**
- c. **3**
- d. **4**

24. Which of the following is the best choice of solvent for the formation of phenyllithium by the reaction of bromobenzene with lithium?

- a. ethanol
- b. tetrahydrofuran
- c. acetic acid
- d. water

25. What is the major organic product obtained from the following sequence of reactions?



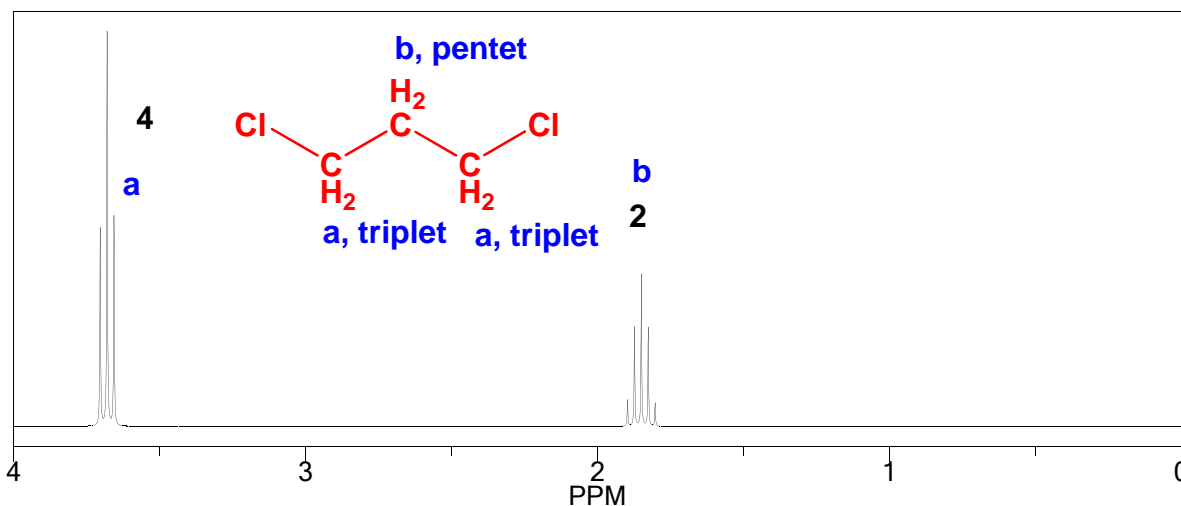
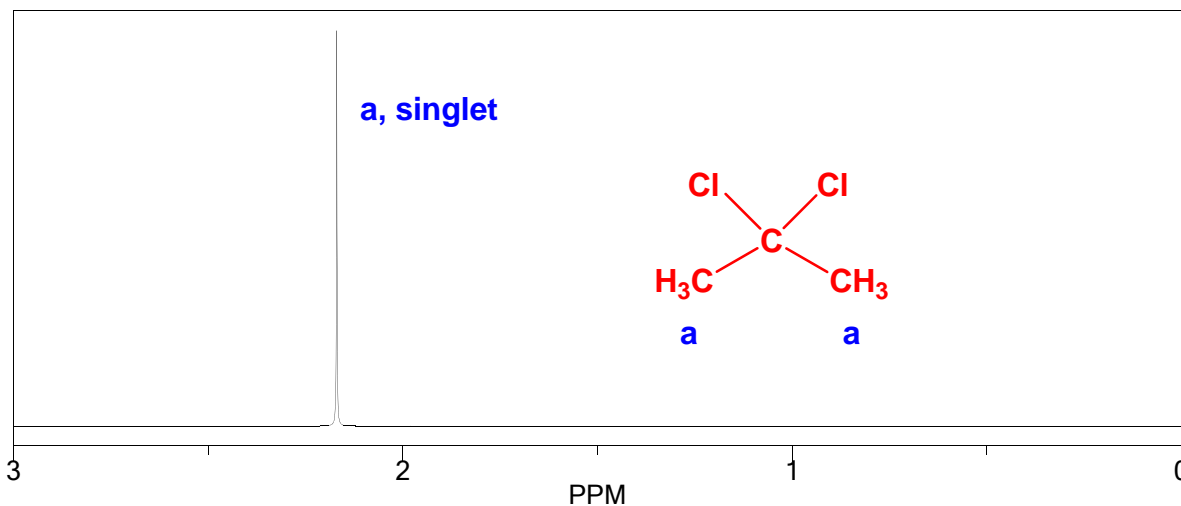
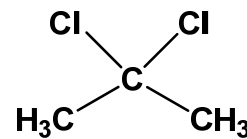
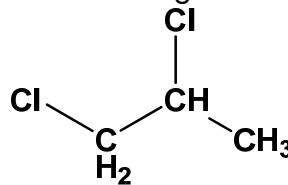
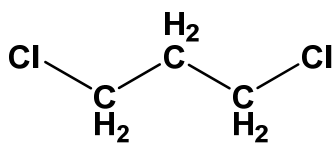
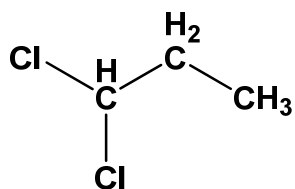
- a. 3-methyl-2-butanol
- b. 2-methylbutane
- c. 3-methyl-1-butanol
- d. 3-methyl-2-butene

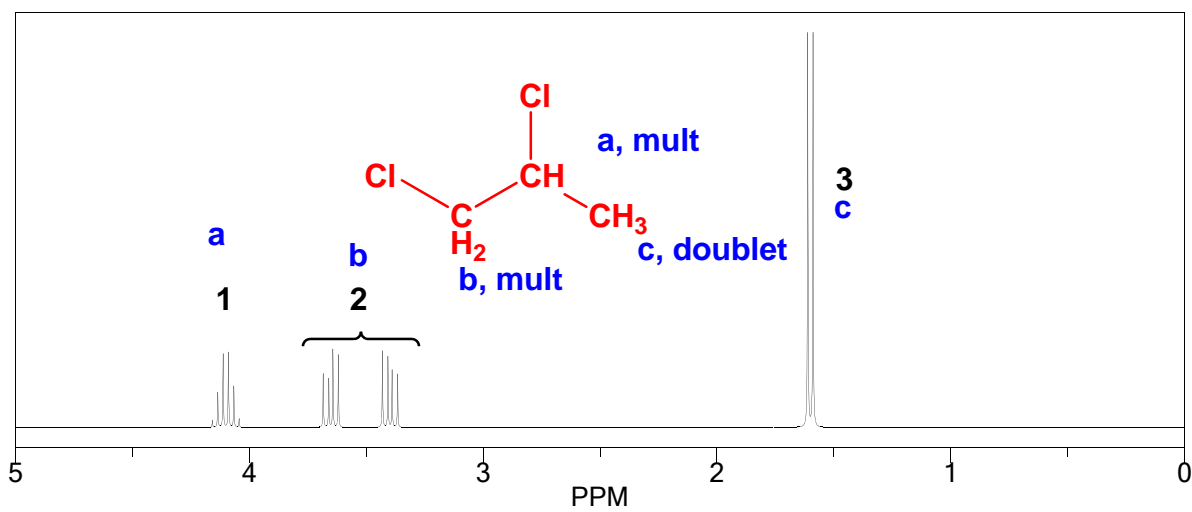
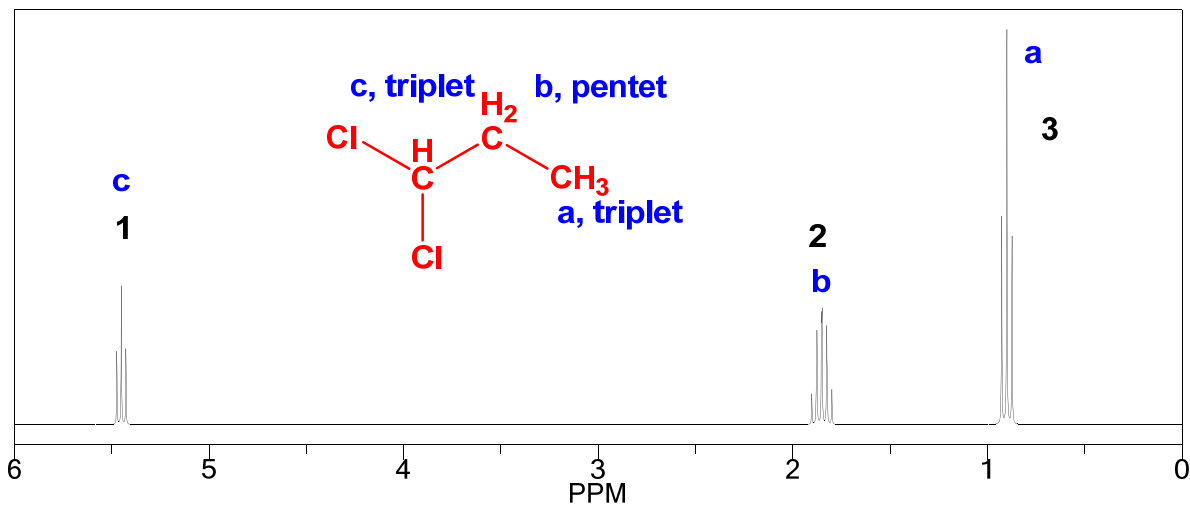
CH310N-Exam I
Answer Section**MULTIPLE CHOICE**

- | | |
|------------|--------|
| 1. ANS: D | PTS: 3 |
| 2. ANS: C | PTS: 3 |
| 3. ANS: B | PTS: 3 |
| 4. ANS: B | PTS: 3 |
| 5. ANS: D | PTS: 3 |
| 6. ANS: C | PTS: 3 |
| 7. ANS: C | PTS: 3 |
| 8. ANS: D | PTS: 3 |
| 9. ANS: D | PTS: 3 |
| 10. ANS: C | PTS: 3 |
| 11. ANS: B | PTS: 3 |
| 12. ANS: D | PTS: 3 |
| 13. ANS: D | PTS: 3 |
| 14. ANS: D | PTS: 3 |
| 15. ANS: C | PTS: 3 |
| 16. ANS: D | PTS: 3 |
| 17. ANS: A | PTS: 3 |
| 18. ANS: B | PTS: 3 |
| 19. ANS: C | PTS: 3 |
| 20. ANS: A | PTS: 3 |
| 21. ANS: A | PTS: 3 |
| 22. ANS: C | PTS: 3 |
| 23. ANS: B | PTS: 3 |
| 24. ANS: B | PTS: 3 |
| 25. ANS: B | PTS: 3 |

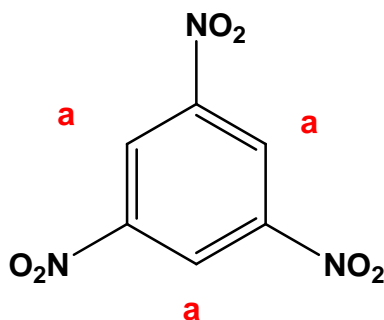
PART 2: Free Style Answer Format (75 pts in this section)

1) The NMRs of four isomers of dichloropropane are shown below. Match each compound with its NMR and provide an interpretation of each spectrum. (i.e. draw the structure on the NMR and label protons, with their splitting.) (5pts each NMR-with assignments)

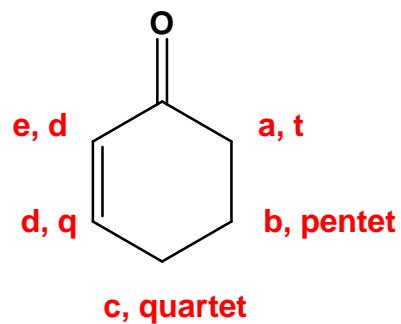
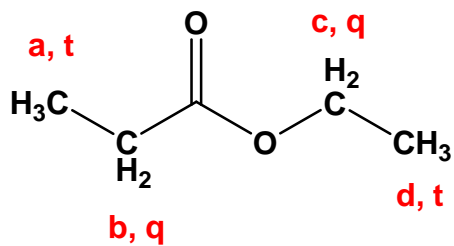




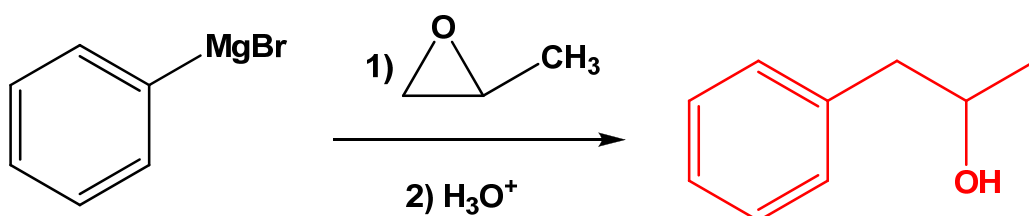
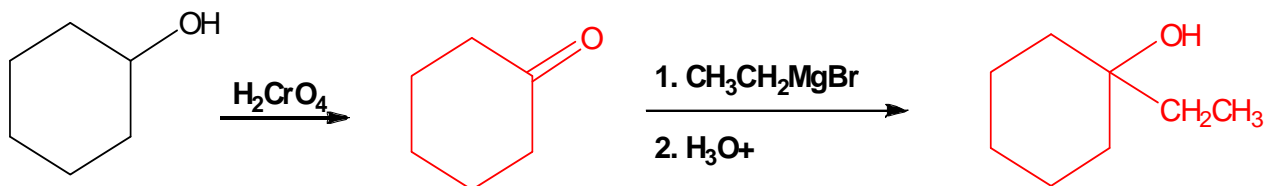
2) Label the protons of the following compounds using the "a,b,c," labeling system **AND** indicate the splitting patterns for each. (Use s=singlet; d=doublet; t=triplet; q=quartet etc. If there are more than 7 peaks, simply use m=multiplet.) (5 pts per structure)



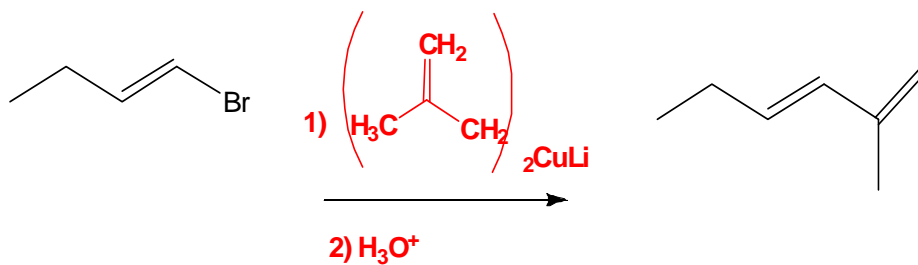
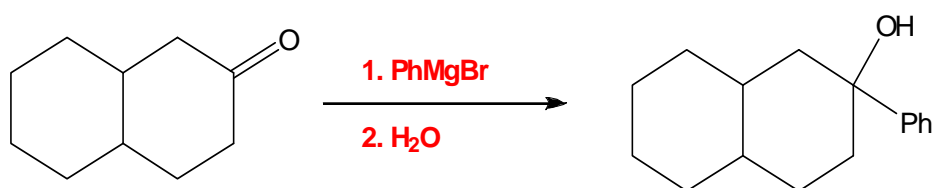
All equivalent: 1 singlet



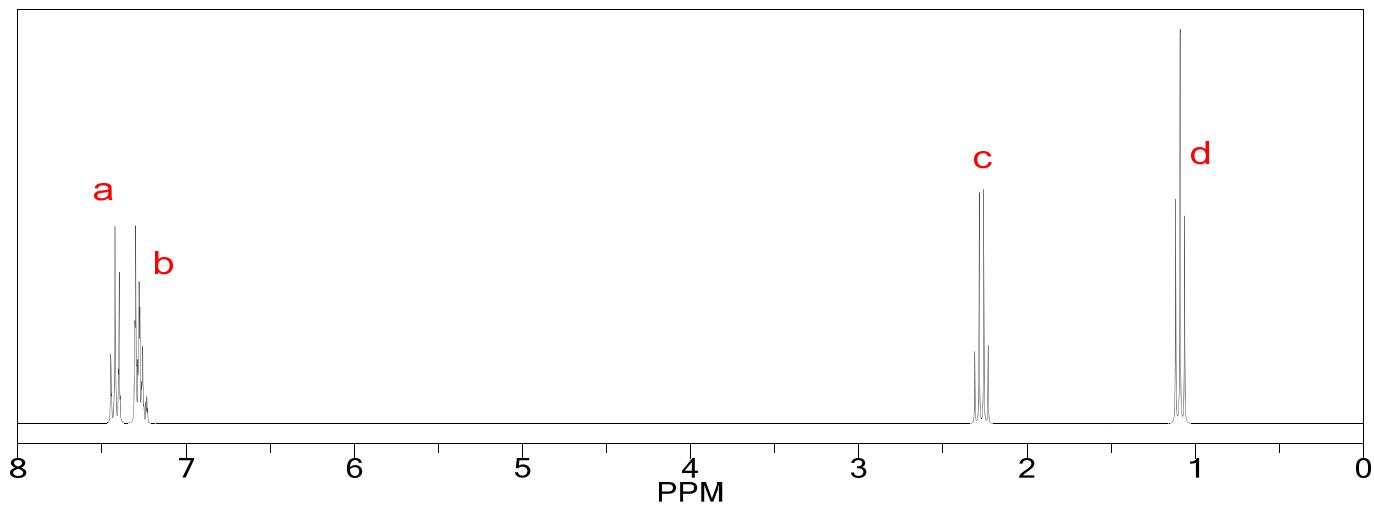
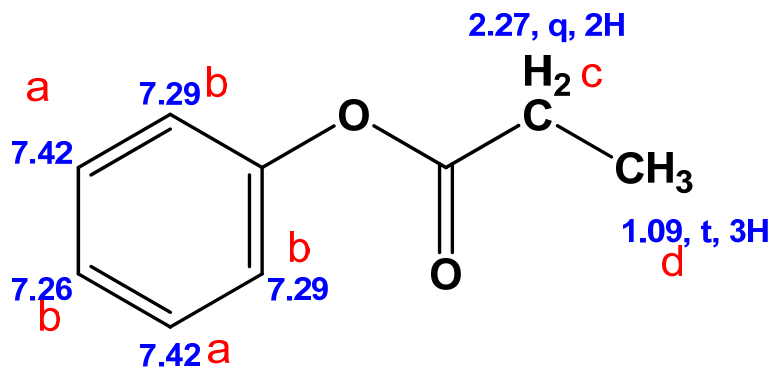
3) Provide the **products** for the following sequence(s) (10 pts):



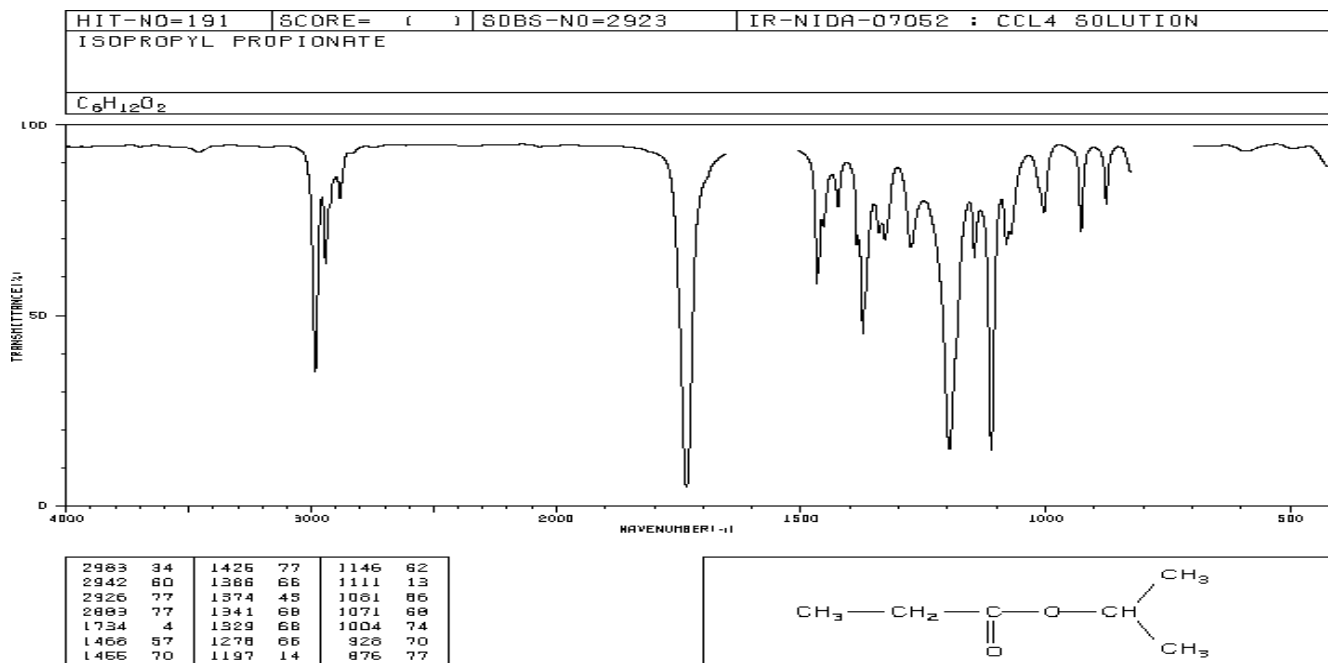
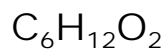
4) Provide the **reagents** for the following sequence (10 pts):



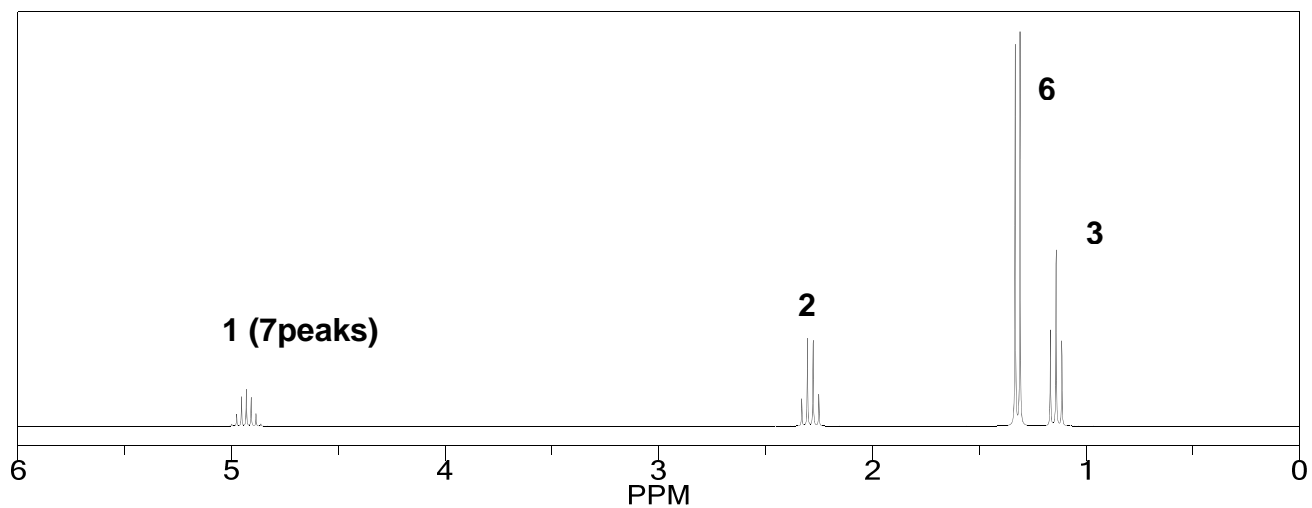
5) Assign, (using the abc labeling method) the protons to the NMR spectrum below and include the splitting (doublet, triplet etc.). (10 pts)



6) The spectra of an unknown compound are shown below. Interpret & summarize the key features of each spectrum (in the space provided) and propose a structure. (15 pts)



^1H NMR- (Integers indicate relative integration of protons)



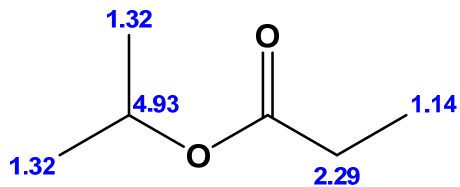
CH 310 N EXAM #1

UTEID **KEY**

IR: 3000 aliphatic; 1730, C=O; 1100 C—O

NMR: 4 types of protons 4.93, m (or heptet), 1H; 2.29, q, 2H; 1.32, d, 6H; 1.14, t, 3H

Proposed Structure:



Proton Assignments

END OF EXAM SECTION