

LAST NAME:

FIRST NAME:

UTEID:

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.

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CH 310 N
EXAM I
MWF 11 AM

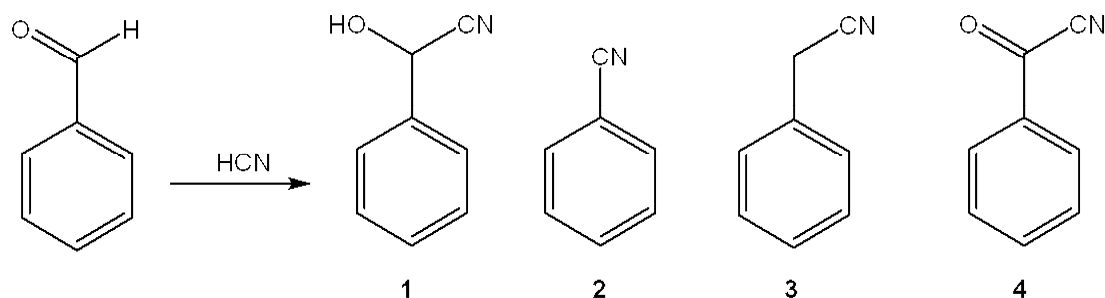
Question	Value	Score
1	15	
2	16	
3	12	
4	12	
5	10	
6	10	
Section II	75	
Section I	75	
Raw Total	150	
Grade		

CH310N-Exam I Version 1

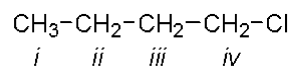
Objective Test Section

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)

- Which feature in the ^1H NMR spectrum provides information about the electronic environment of the protons in a compound?
 - splitting
 - chemical shift
 - integral
 - number of signals
- What is the major organic product obtained from the following sequence of reactions?

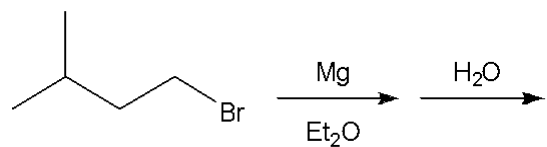


- 1
 - 2
 - 3
 - 4
- Which of the protons in the following molecule appear furthest **downfield** in the ^1H NMR spectrum?



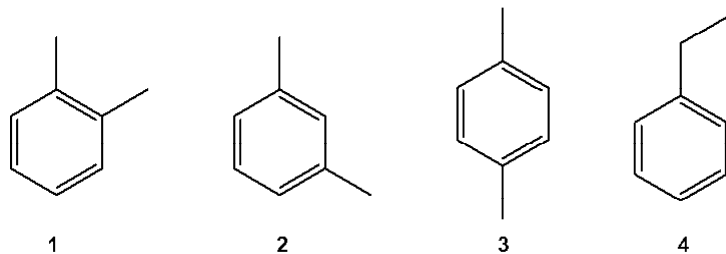
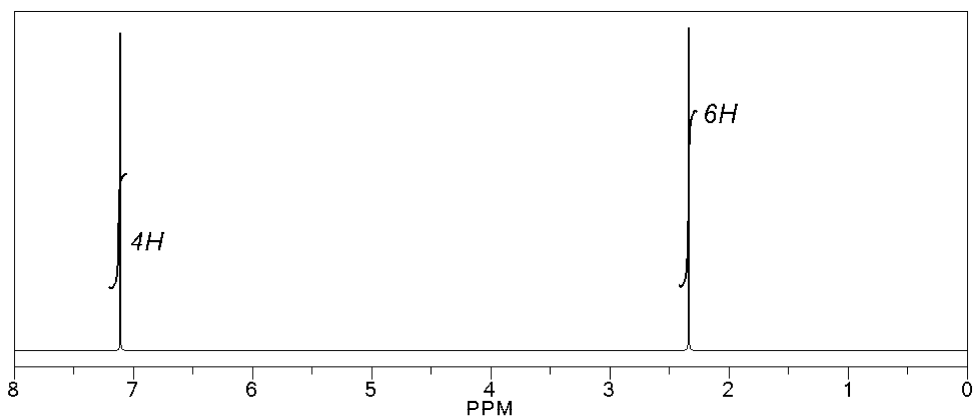
- i*
- ii*
- iii*
- iv*

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



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

5. Which C₈H₁₀ compound gives the following ¹H NMR spectrum?

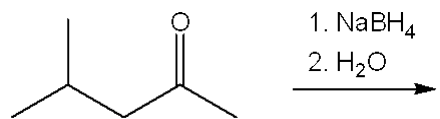


- a. **1**
- b. **2**
- c. **3**
- d. **4**

6. Which of the following laws relates the frequency of a stretching vibration to the masses and spring constant of a simple harmonic oscillator?

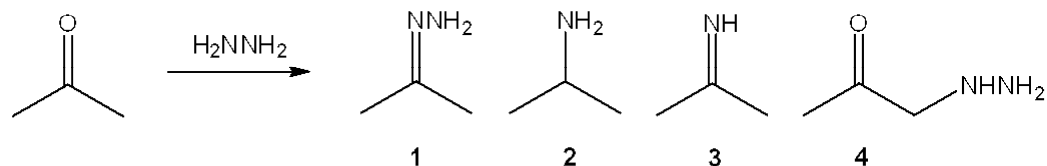
- a. Pan's law
- b. Barrie's law
- c. Peter's law
- d. Hooke's law

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



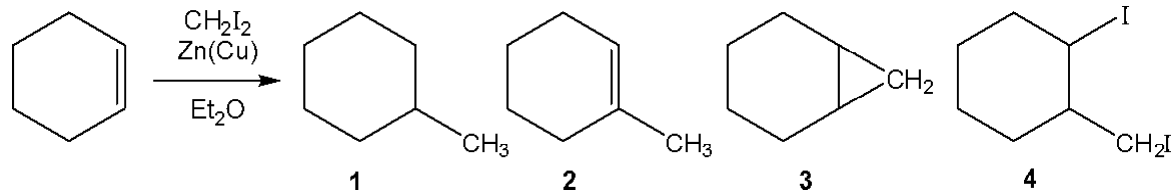
- a. 4-methyl-1-pentene
- b. 4-methyl-2-pentanol
- c. 2-methylpentane
- d. (*E*) 4-methyl-2-pentene

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



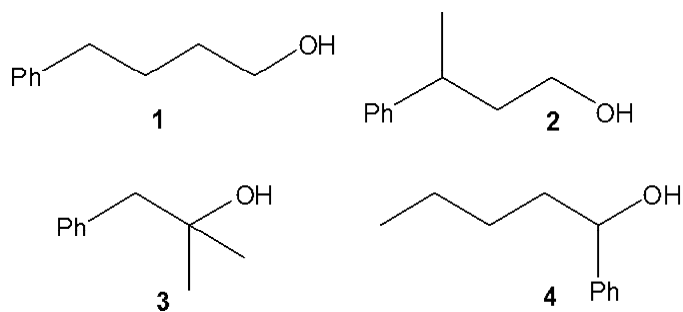
- a. **1**
- b. **2**
- c. **3**
- d. **4**

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



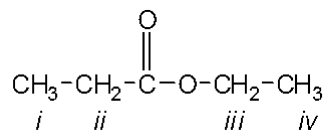
- a. **1**
- b. **2**
- c. **3**
- d. **4**

10. Which of the following alcohols can be prepared from a Grignard reagent and ethylene oxide?



- a. only 1
- b. only 1 and 2
- c. only 1, 2 and 3
- d. 1, 2, 3 and 4

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



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

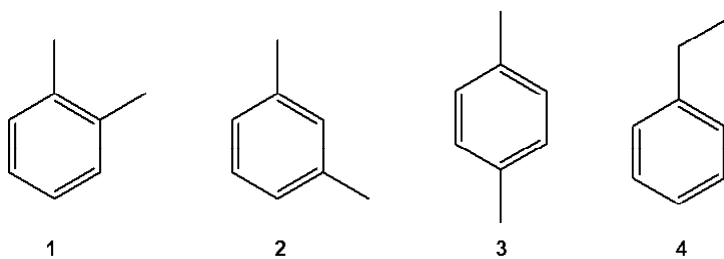
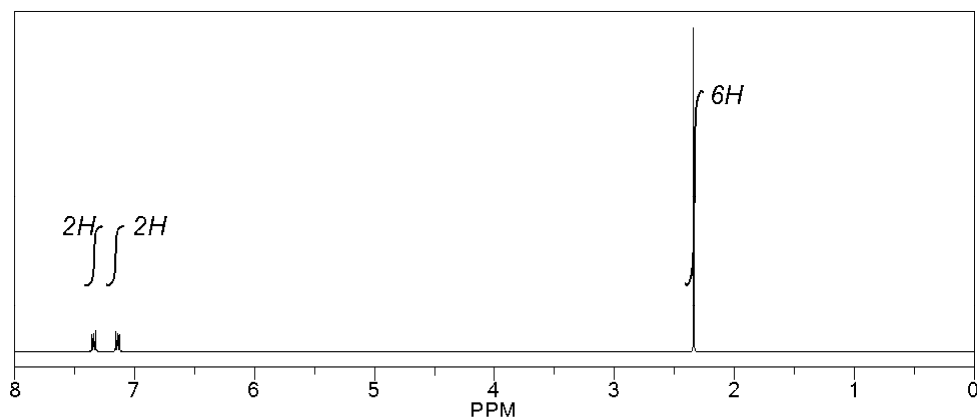
12. What is the hydrogen deficiency index for a compound with a molecular formula of $\text{C}_{10}\text{H}_{16}\text{O}_2$?

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

13. Which feature in the ^1H NMR spectrum provides information about the number of neighboring protons of each proton in the compound?

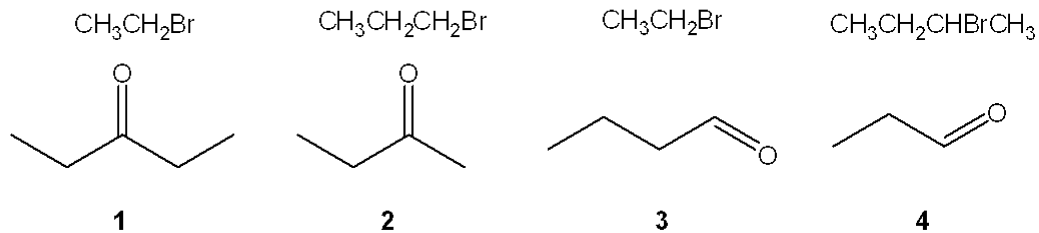
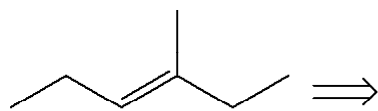
- a. integral
- b. chemical shift
- c. number of signals
- d. multiplicity

14. Which C₈H₁₀ compound gives the following ¹H NMR spectrum?



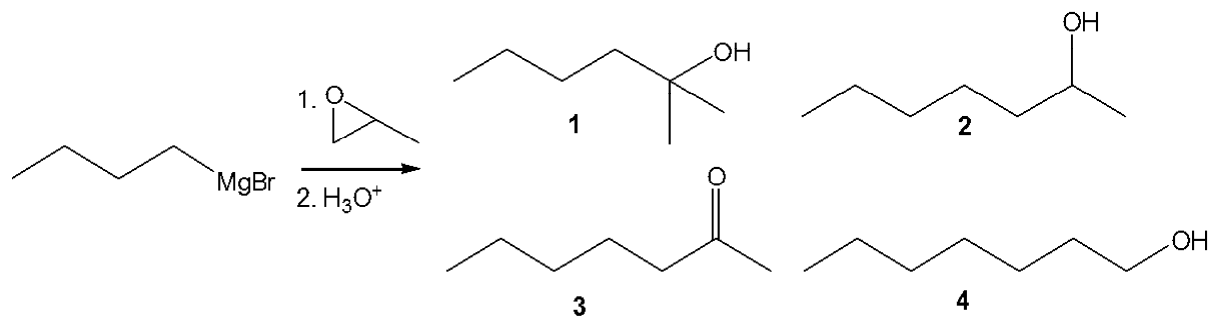
- a. **1**
- b. **2**
- c. **3**
- d. **4**

15. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by reaction of the Wittig reagent derived from the alkyl bromide with the carbonyl compound?



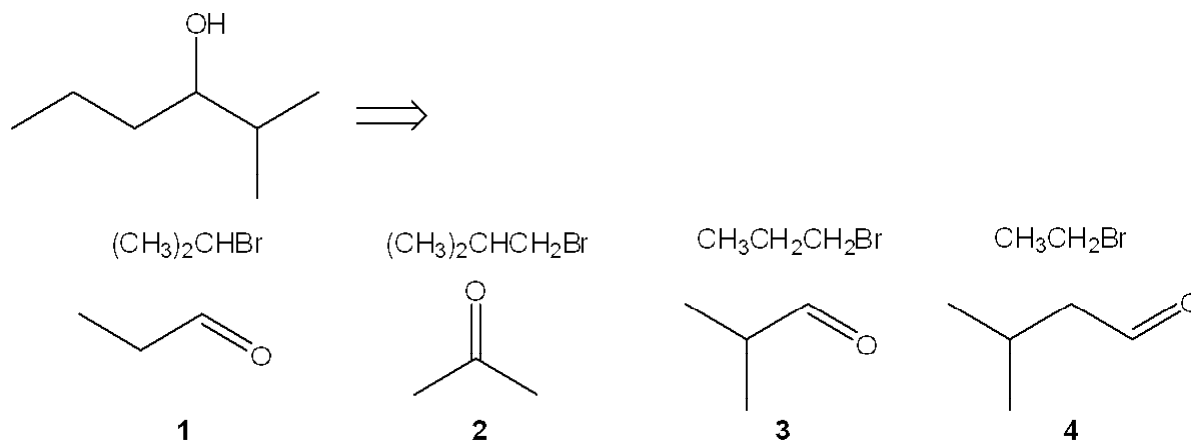
- a. only **1** and **2**
- b. only **2** and **4**
- c. only **2** and **3**
- d. only **1, 2** and **3**

16. What is required for a bond to give an infrared absorption?
- a change in reduced mass during vibration
 - a change in bond angle during vibration
 - a change in bond dipole during vibration
 - a change in bond length during vibration
17. What is the major organic product obtained from the following reaction?

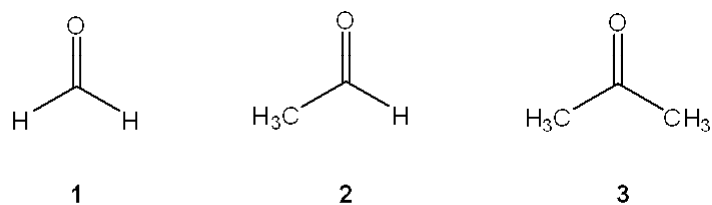


- 1**
 - 2**
 - 3**
 - 4**
18. Which feature in the ^1H NMR spectrum provides information about the number of types of different protons in a compound?
- integral
 - number of signals
 - splitting
 - chemical shift

19. 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?

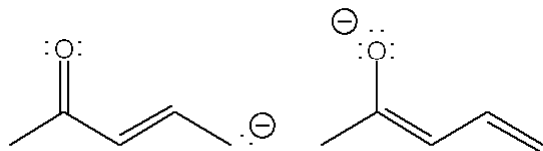


- a. only **1**
 b. only **3**
 c. only **1** and **3**
 d. only **2** and **4**
20. Which of the following functional groups is likely to be present in a molecule that has peaks in the infrared spectrum at $3200\text{-}3650\text{ cm}^{-1}$ (strong), but does not have peaks at $1630\text{-}1820$ or $1000\text{-}1250\text{ cm}^{-1}$
- a. alcohol
 b. aldehyde or ketone
 c. ether
 d. ester
21. What is the correct assignment of the names of the following aldehydes and ketones?

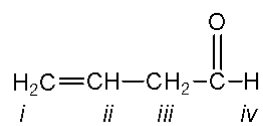


- a. **1** = acetaldehyde; **2** = acetone; **3** = acetophenone
 b. **1** = acetaldehyde; **2** = acetophenone; **3** = benzophenone
 c. **1** = acetone; **2** = acetaldehyde; **3** = formaldehyde
 d. **1** = formaldehyde; **2** = acetaldehyde; **3** = acetone

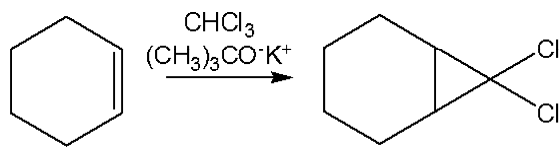
22. What is the relationship between the following two structures?



- a. tautomers
 - b. stereoisomers
 - c. resonance structures
 - d. constitutional isomers, but not tautomers
23. Which of the protons in the following molecule appear at the highest δ -value in the ^1H NMR spectrum?

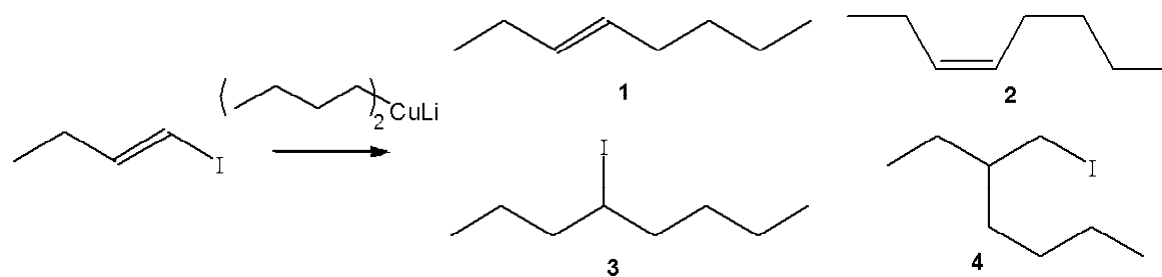


- a. *i*
 - b. *ii*
 - c. *iii*
 - d. *iv*
24. What reactive intermediates are involved in the following reaction?



- a. the cyclic chloronium ion derived from cyclohexene
- b. the trichloromethyl cation (Cl_3C^+)
- c. the cyclohexyl carbocation
- d. the trichloromethyl anion (Cl_3C^-) and dichlorocarbene ($\text{Cl}_2\text{C}:$)

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

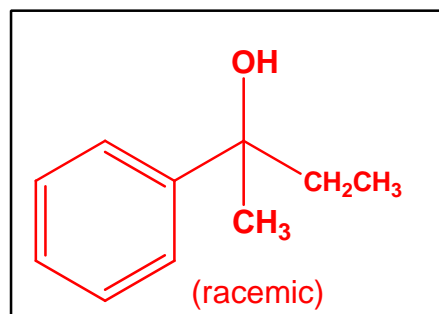
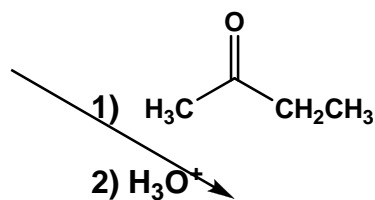
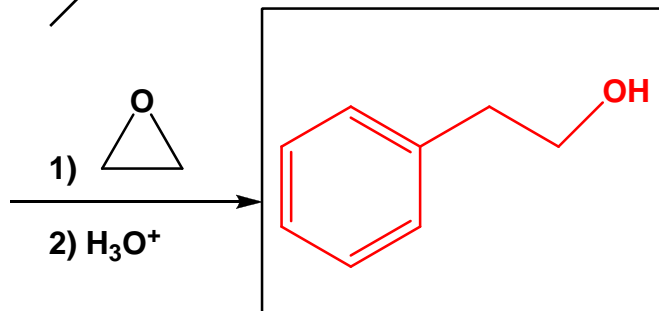
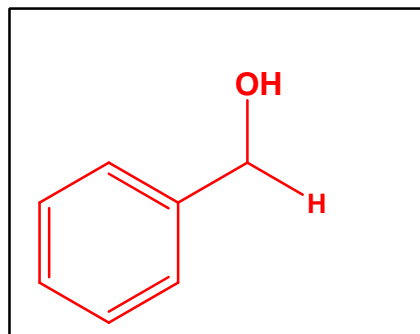
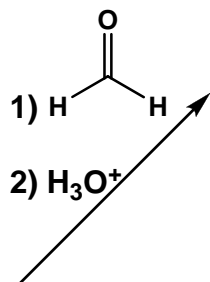
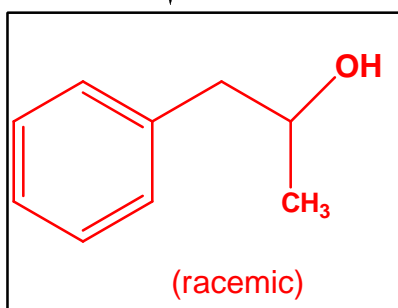
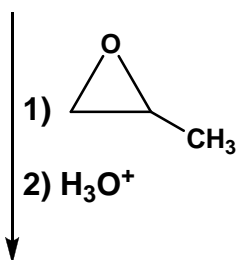
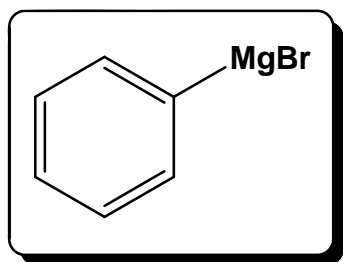
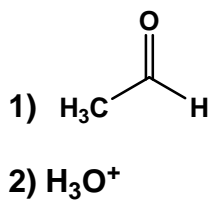
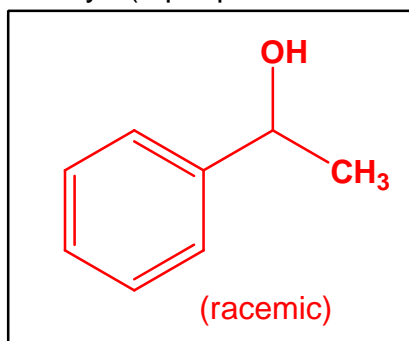


- a. **1**
- b. **2**
- c. **3**
- d. **4**

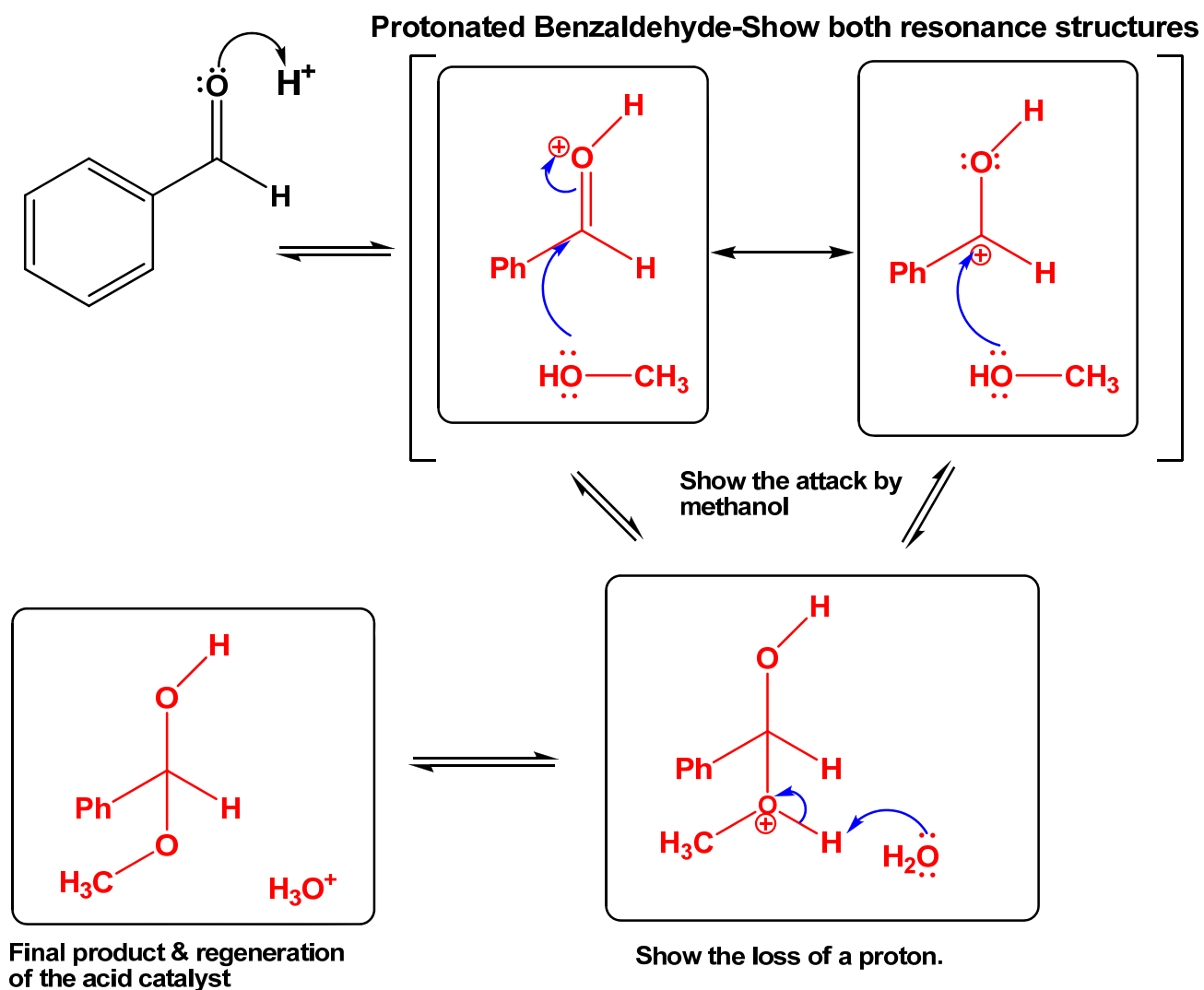
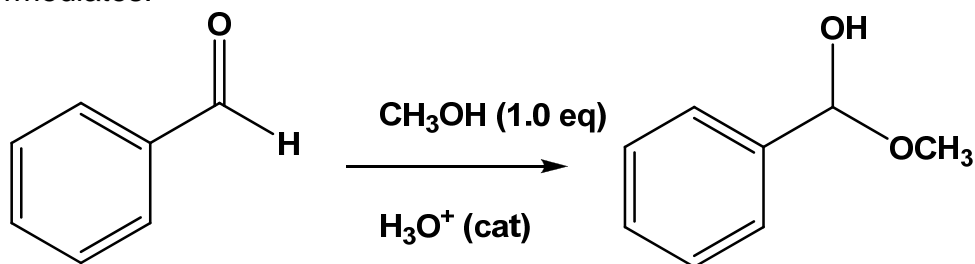
CH310N-Exam I version 1
Answer Section**MULTIPLE CHOICE**

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

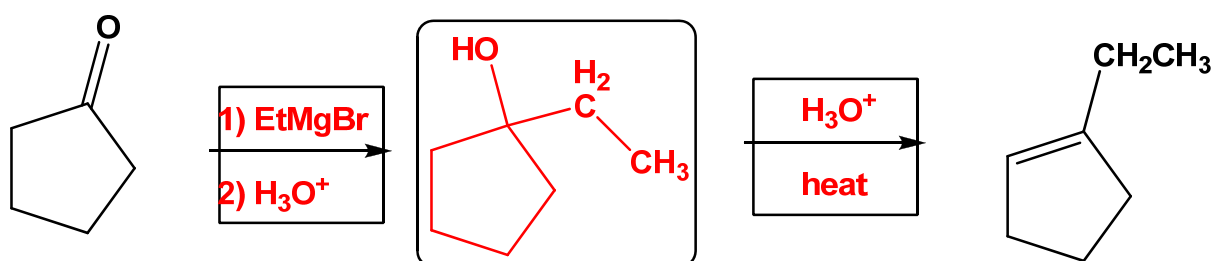
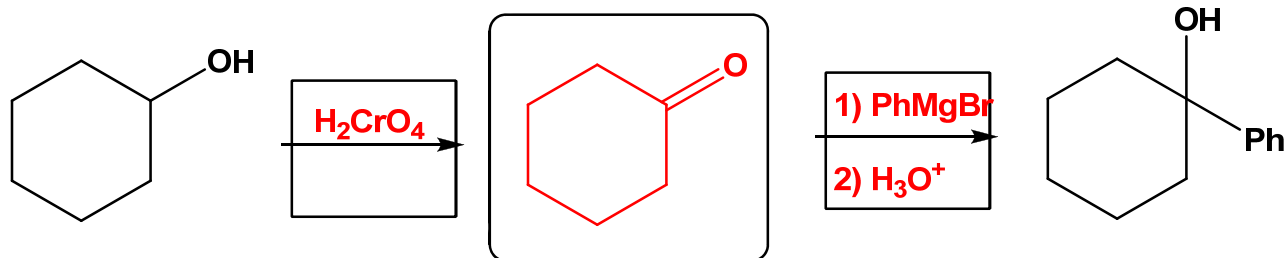
PART 2: Free Style Answer Format (75 pts in this section)

1) Reactions: Provide the **products** for the following reactions. Show any relevant stereo and regiochemistry. (3 pts per structure-n-a-box)

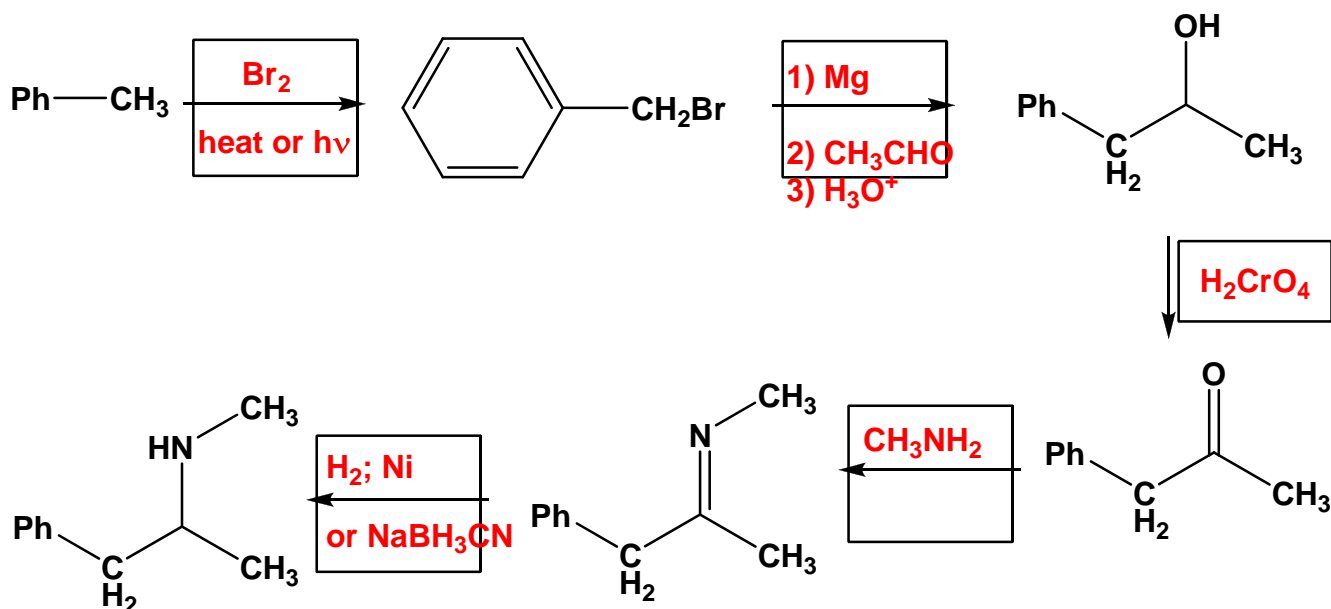
2) **Mechanism:** Provide a mechanism for the following transformation. Show all important flows of electrons, charges and intermediates. Where indicated, (in the structure-n-a-box)- draw the intermediates.



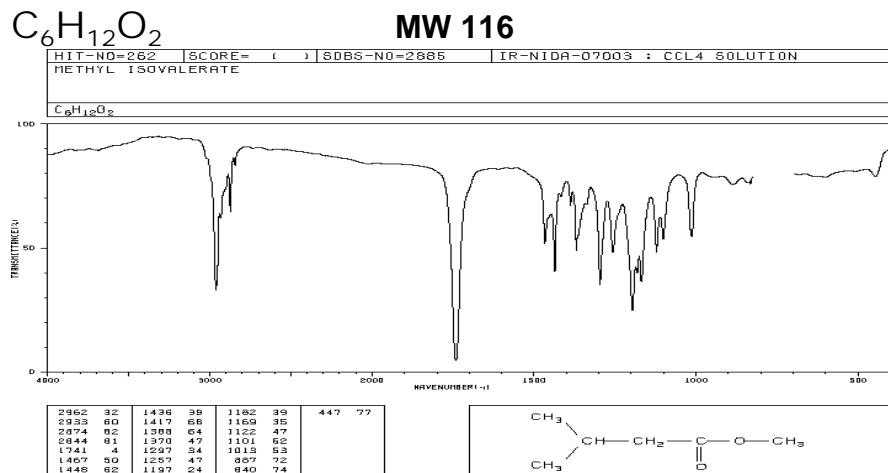
3) **Texas two-step:** Provide both the reagents (in square boxes) and the product (rounded box) for these synthesis. (Note, that a second reagent may be required in the square boxes. For example, the acid step of a Grignard addition.) (12 pts):



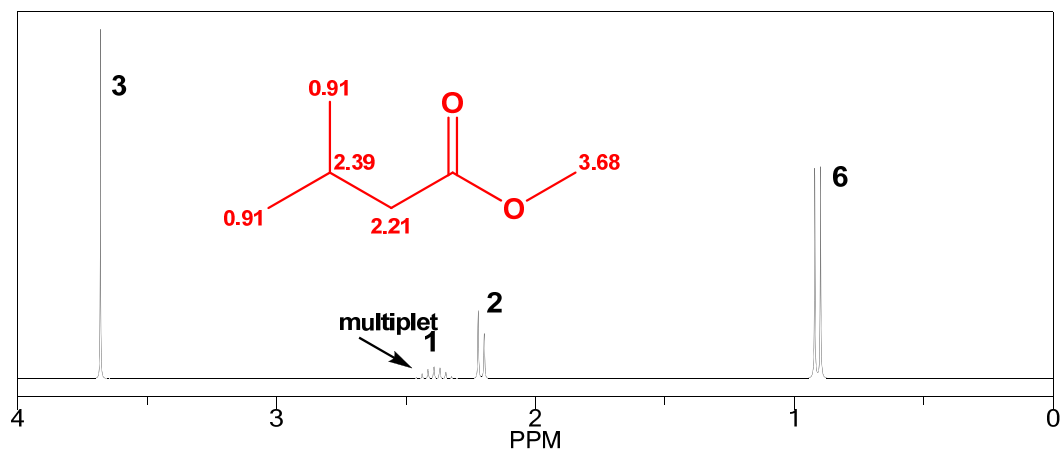
4) **Multi-step synthesis:** Provide the reagents for the following conversions. (12 pts)



5) **Unknowns:** 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. (10 pts for unknown & interpretation)

Unknown 1

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

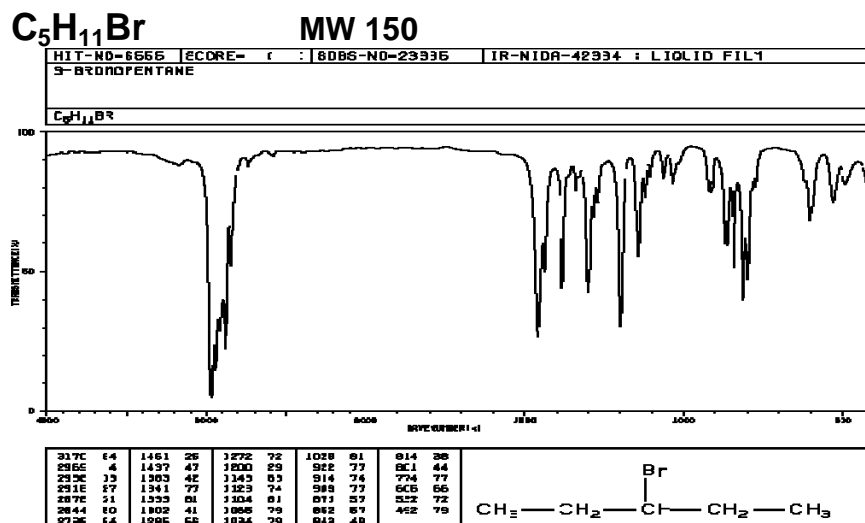


IR: **C—H stretch, aliphatic $<3000\text{ cm}^{-1}$; C=O, 1740 cm^{-1} ; C—O 1050 cm^{-1}**

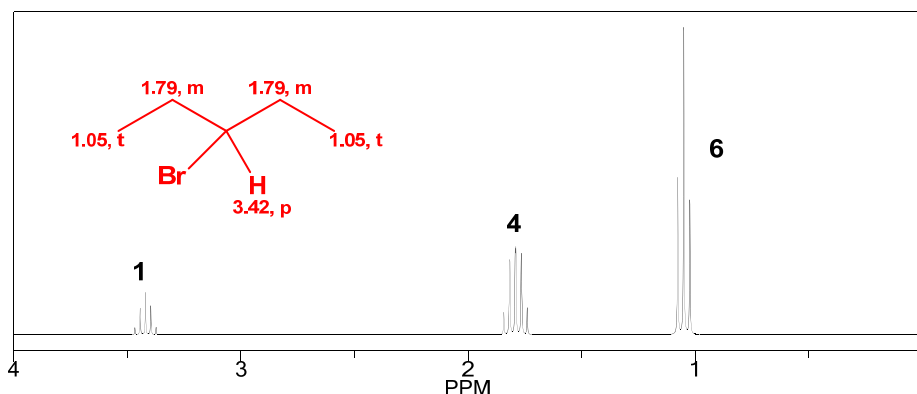
1H NMR: **3.68, s, 3H; 2.39, multiplet, 1H; 2.21, d, 2H; 0.91, d, 6H**



6) **Unknown:** 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. (10 pts for unknown & interpretation)

Unknown 2

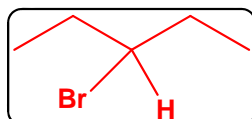
¹H NMR- (Integers indicate relative integration of protons)



IR: Aliphatic C—H stretches < 3000 cm⁻¹

¹H NMR: 3.42, pentet, 1H; 1.79, multiplet or (d of q), 4 H; 1.05, t, 6H

Proposed Structure:



END OF EXAM SECTION

LAST NAME:

FIRST NAME:

UTEID:

COVER PAGE

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**CH 310 N
EXAM 2**

MWF 11 AM

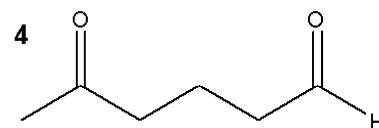
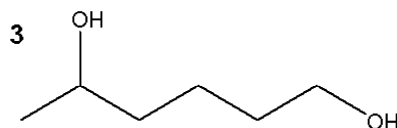
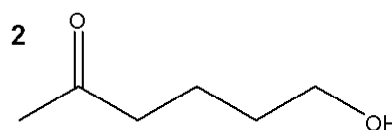
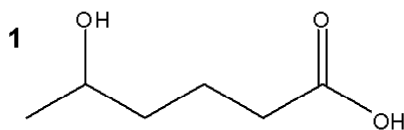
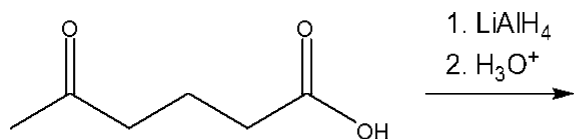
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Section II	75	
Section I	75	
Raw Total	150	
Grade		

CH310N-Exam II version 1

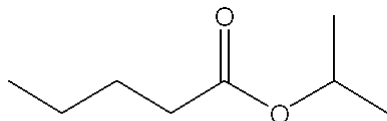
Objective Test Section

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

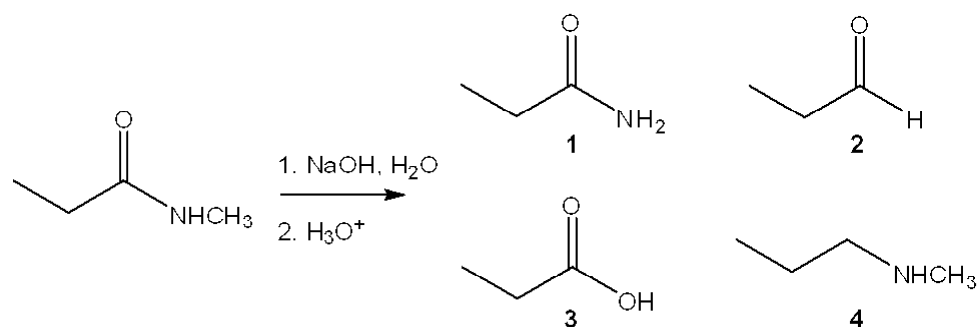


- a. 1
b. 2
c. 3
d. 4
2. Which of the following statements is *not* true in relation to the hydrolysis of esters?
- Hydrolysis of esters under basic conditions requires a stoichiometric amount of hydroxide
 - Under basic conditions for hydrolysis of esters deprotonation of the ester increases its nucleophilicity
 - Hydrolysis of esters under acid conditions requires only a catalytic amount of a strong acid
 - Under acidic conditions for hydrolysis of esters protonation of the ester increases its electrophilicity
3. What is the IUPAC name of the following compound?



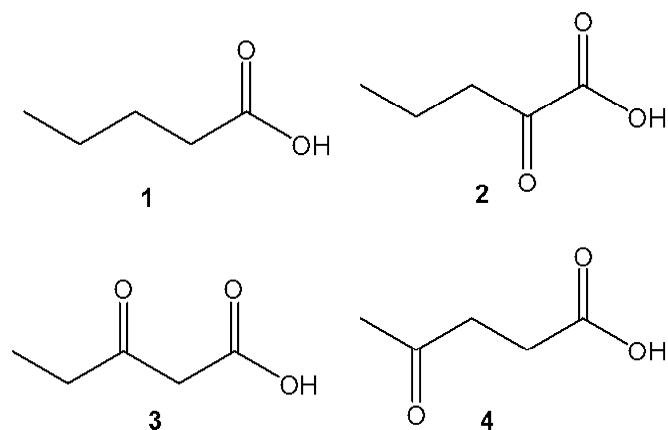
- a. isopropyl pentanoate
b. isopropoxybutanal
c. butyl isopropanoate
d. pentanoyl isopropane

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



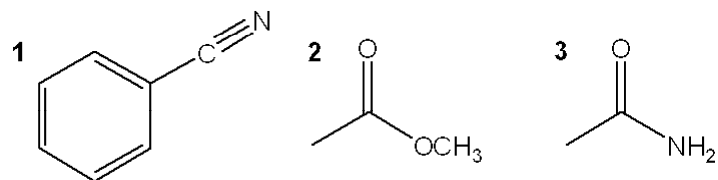
- 1
- 2
- 3
- 4

5. Which of the following carboxylic acids undergoes the **most rapid** thermal decarboxylation reaction?



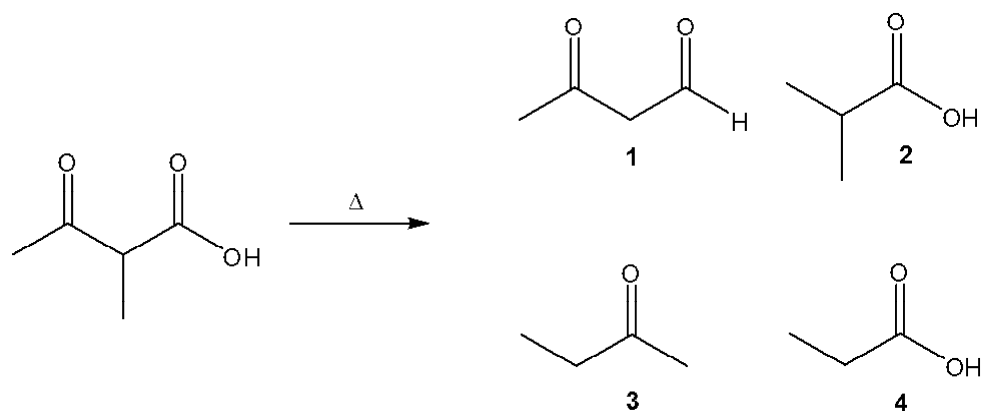
- 1
- 2
- 3
- 4

6. What is the correct assignment of the functional groups in the following compounds?



- 1 = amide; 2 = carboxylic acid; 3 = imide
- 1 = nitrile; 2 = ester; 3 = imide
- 1 = nitrile; 2 = ester; 3 = amide
- 1 = amide; 2 = ester; 3 = nitrile

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

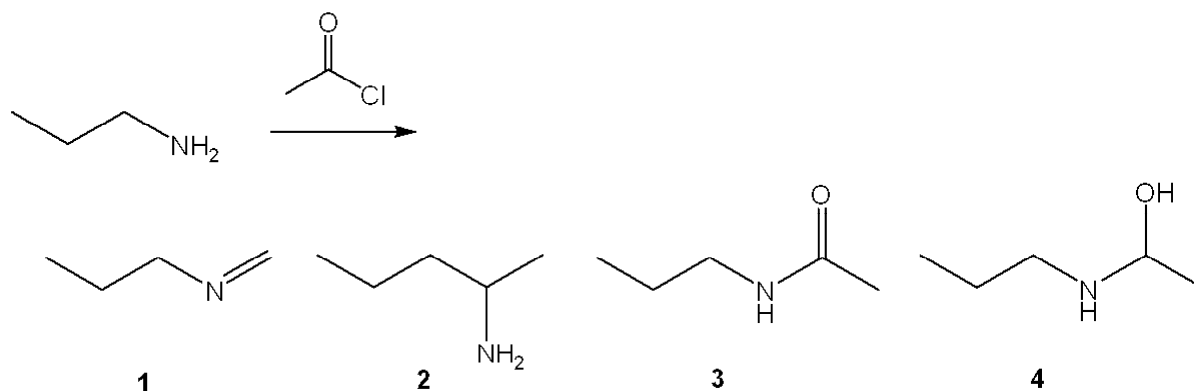


- a. 1
- b. 2
- c. 3
- d. 4

8. One advantage of using enamines over enolates, for alkylation reactions, is:

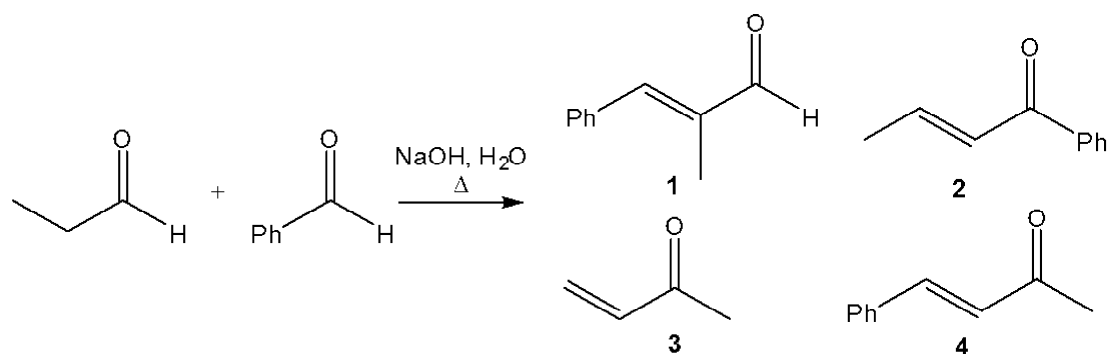
- a. enamines are resistant to acid
- b. enamines undergo monoalkylation
- c. enamines are basic compounds
- d. enamines convert to ketones

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



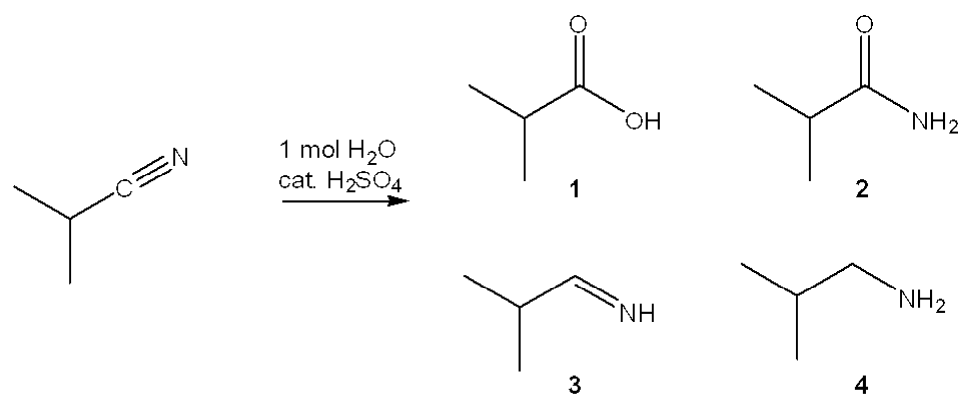
- a. 1
- b. 2
- c. 3
- d. 4

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



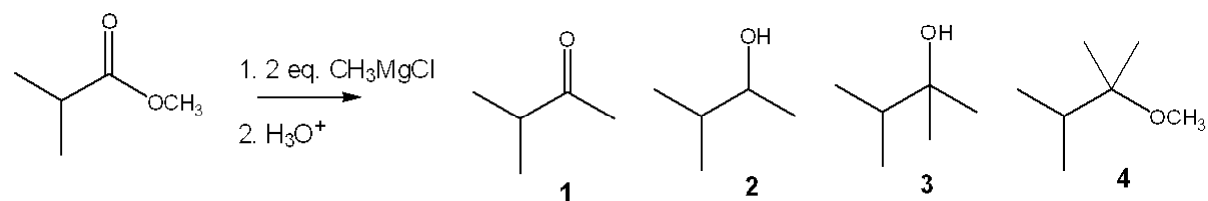
- a. **1**
- b. **2**
- c. **3**
- d. **4**

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



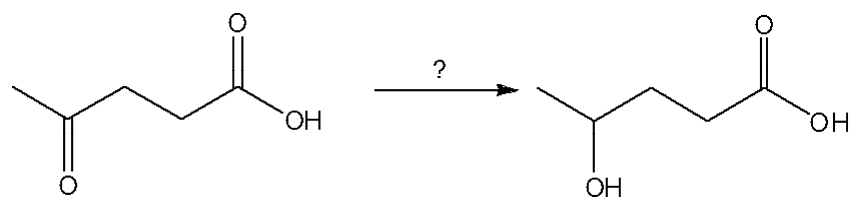
- a. **1**
- b. **2**
- c. **3**
- d. **4**

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



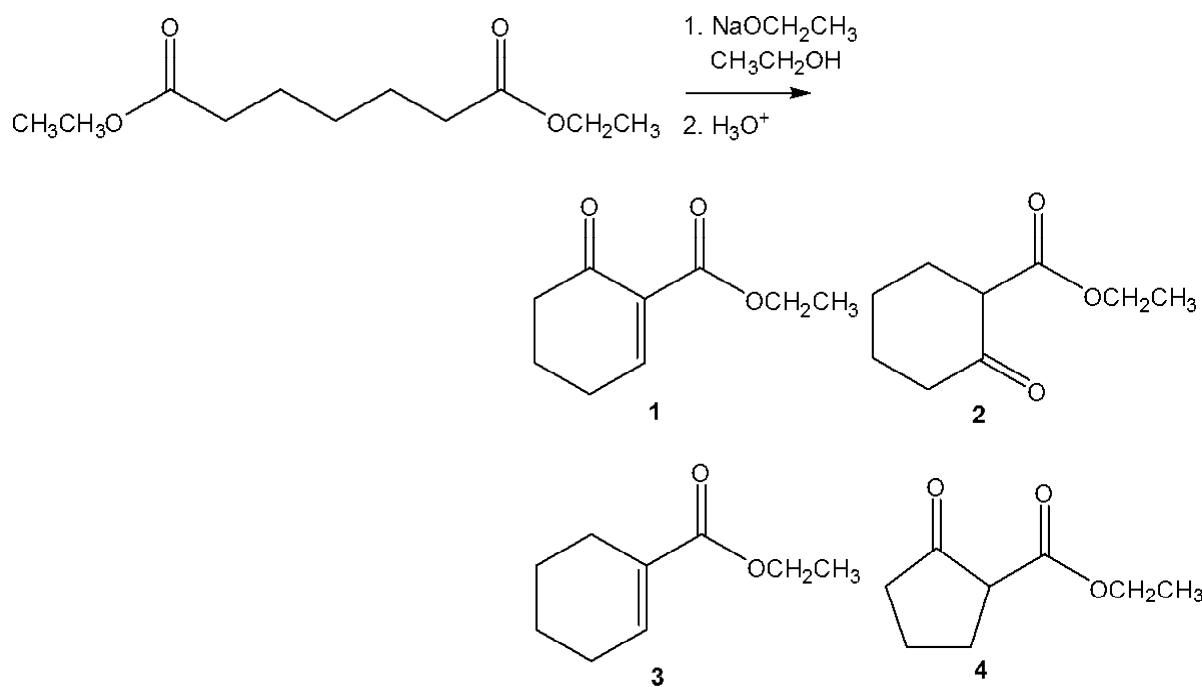
- a. **1**
- b. **2**
- c. **3**
- d. **4**

13. What is the best choice of reagent(s) to perform the following transformation?



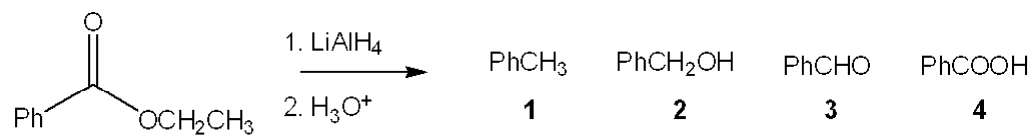
- a. H_2, Pt
- b. NaH
- c. 1. NaBH_4 ; 2. H_2O
- d. 1. LiAlH_4 ; 2. H_3O^+

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



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

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

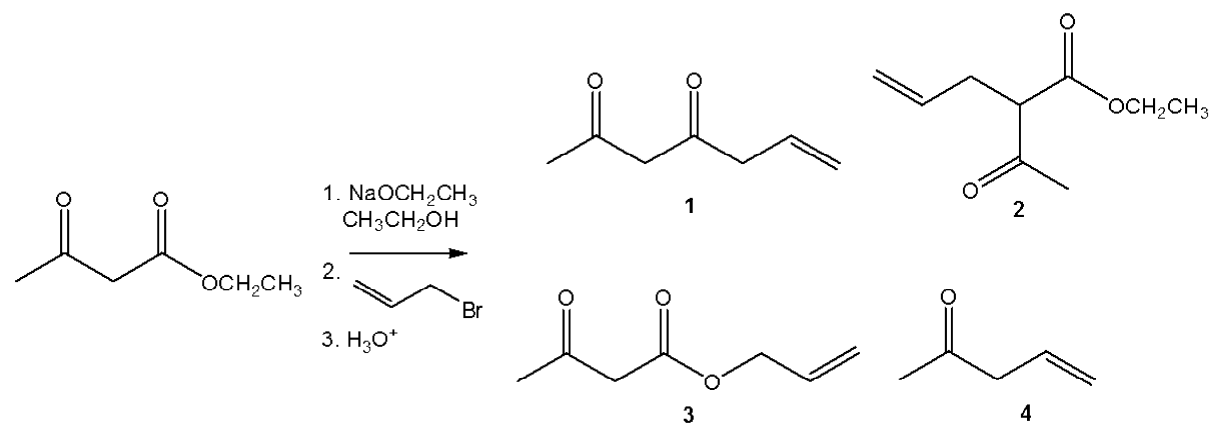


- a. 1
- b. 2
- c. 3
- d. 4

16. Which of the following has the highest boiling point?

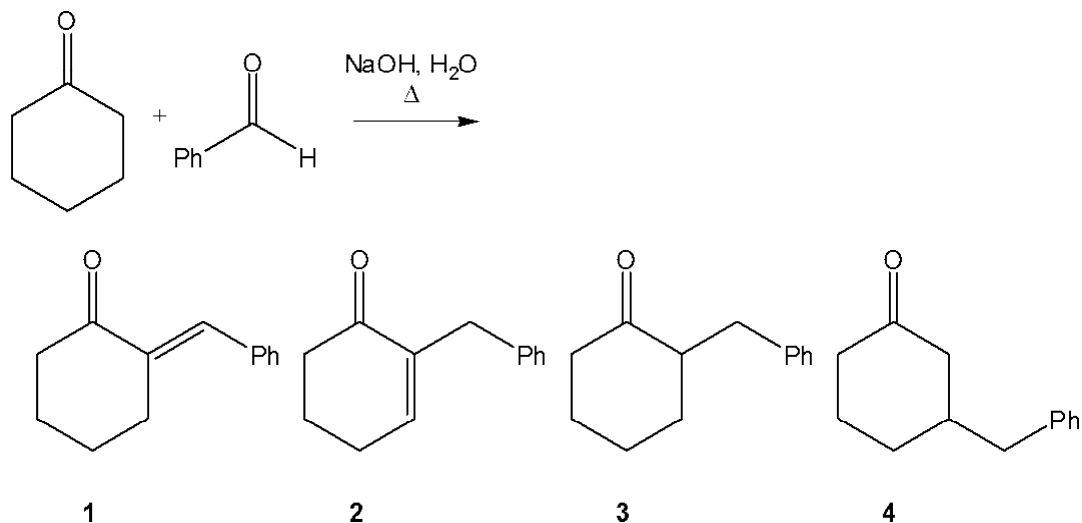
- a. pentanal
- b. pentanol
- c. butanoic acid
- d. acetic acid

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



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

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



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

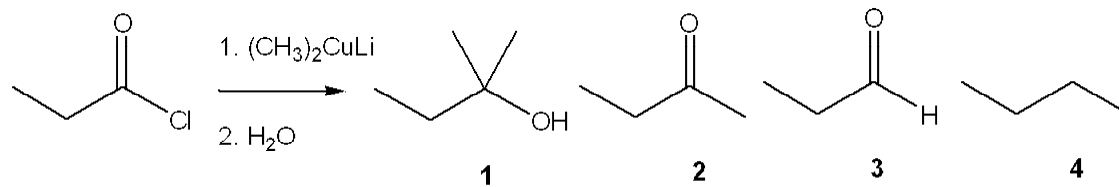
19. Which of the following is the correct order of decreasing acid strength (more acidic > less acidic)?

- a. $\text{CH}_3\text{COOH} > \text{ClCH}_2\text{COOH} > \text{CH}_3\text{OH}$
- b. $\text{CH}_3\text{CH}_2\text{OH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH}$
- c. $\text{FCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{CH}_3\text{OH}$
- d. $\text{FCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{F}_2\text{CHCOOH}$

20. A limitation of using enolates for synthesis is:

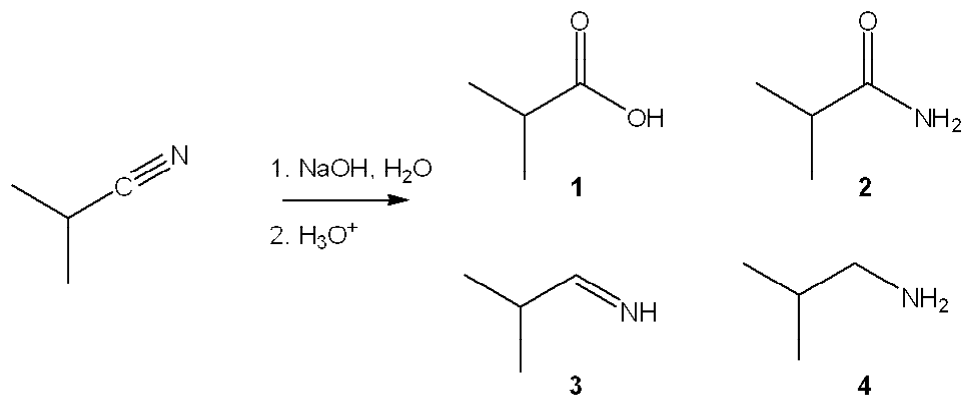
- a. polyalkylation
- b. enolates are nucleophiles
- c. enolates are generated in acid
- d. enolates polymerize

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



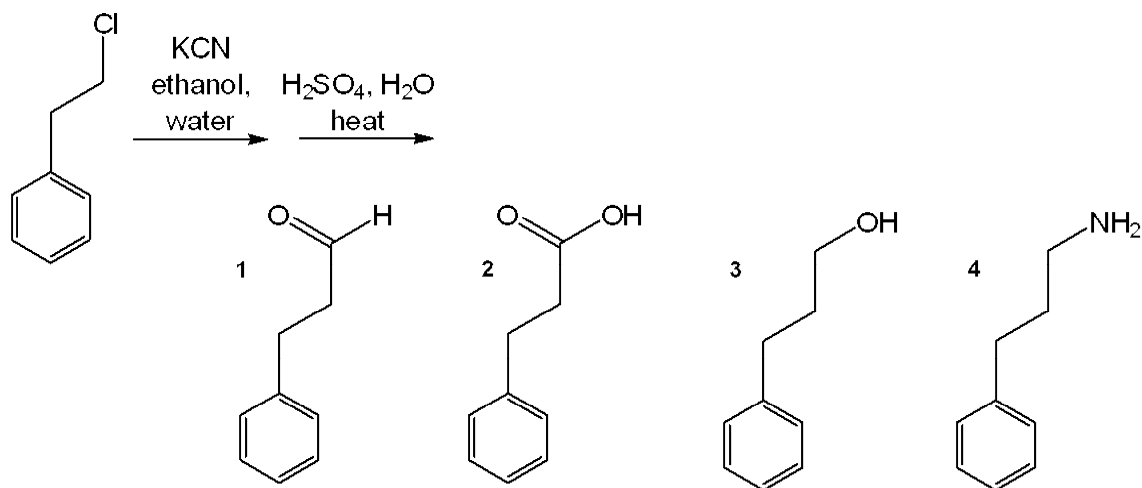
- a. **1**
- b. **2**
- c. **3**
- d. **4**

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



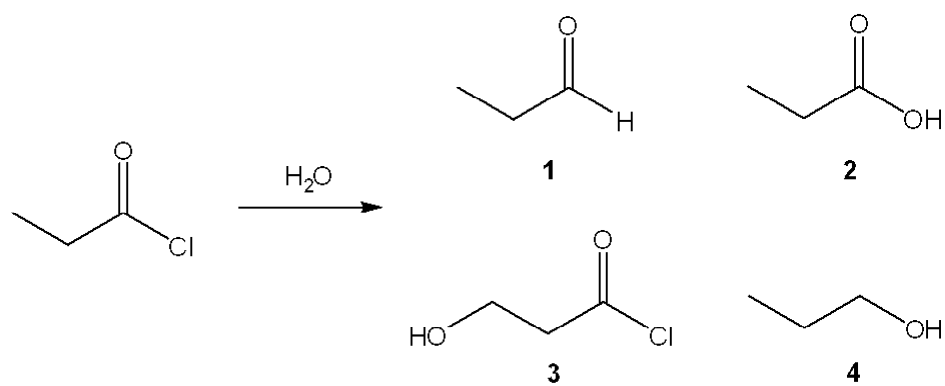
- a. **1**
- b. **2**
- c. **3**
- d. **4**

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



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

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



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

25. What is the approximate $\text{p}K_a$ value of acetic acid

- a. 35
- b. 15
- c. -2
- d. 5

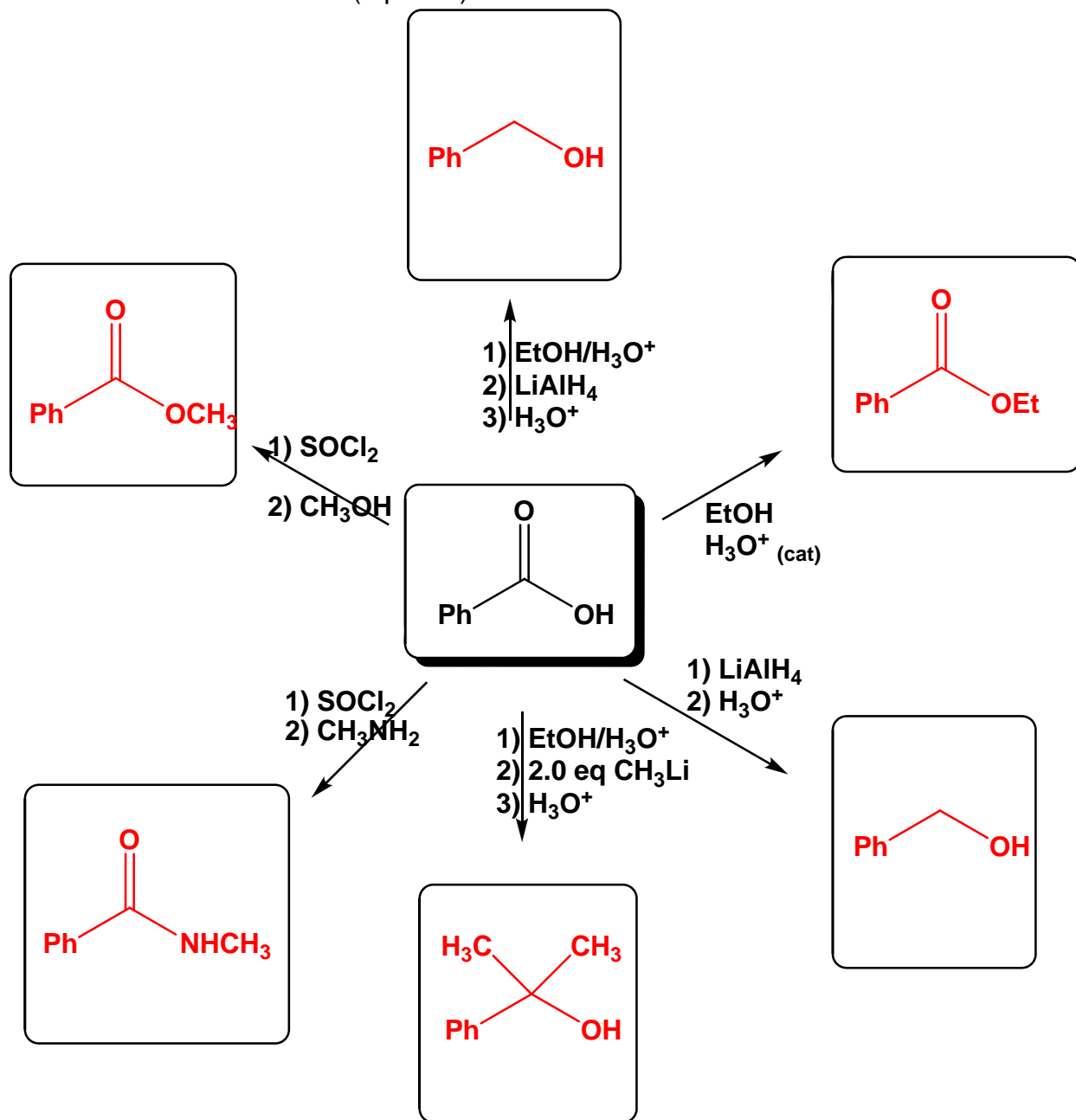
CH310N-Exam II version 1
Answer Section**MULTIPLE CHOICE**

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

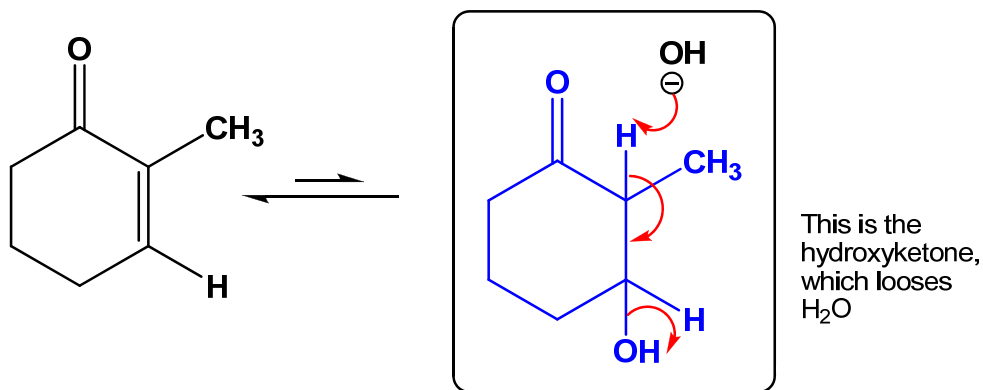
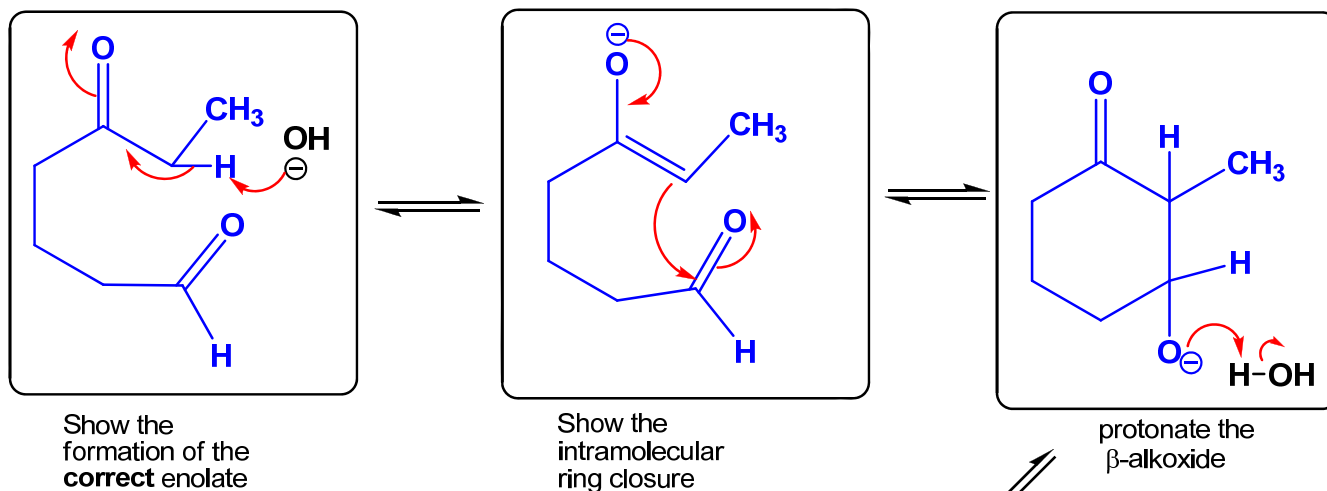
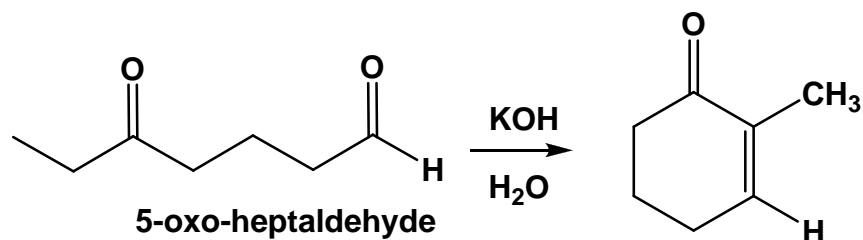
PART 2: Free Style Answer Format

(75 pts in this section)

1) Provide the product for the following reactions. This is not a mechanism question—simply write the answers in the boxes. (2 pts ea)



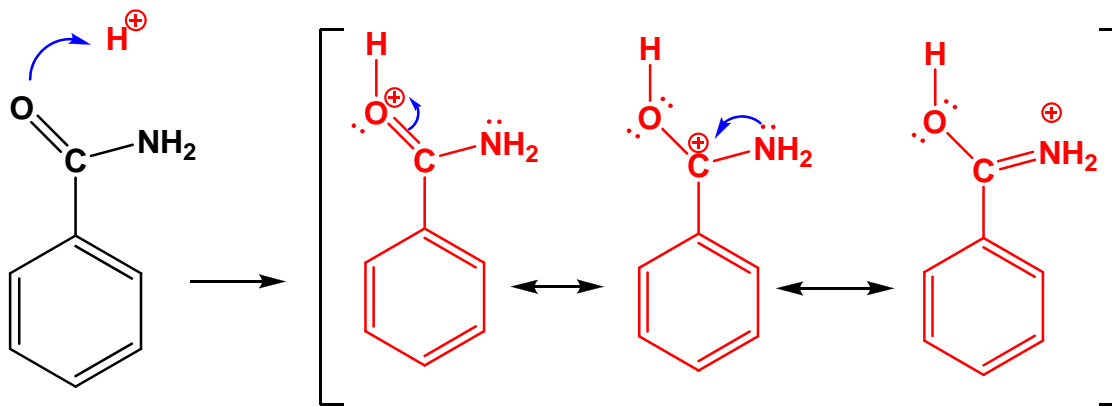
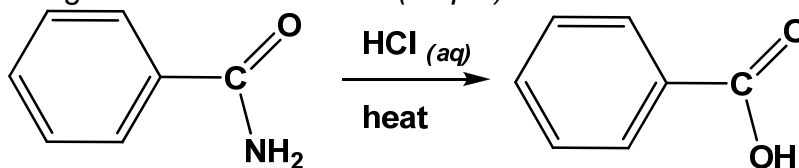
2) **Mechanism:** Provide a mechanism for the following transformation. Show all important flows of electrons, charges and intermediates. (12 pts)



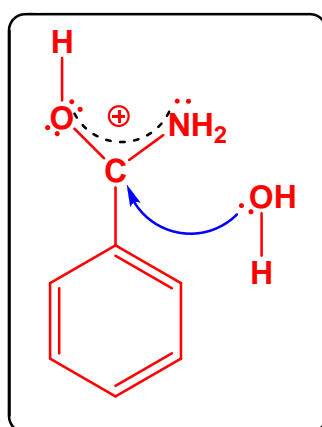
CH 310 N EXAM #2

UTEID **KEY**

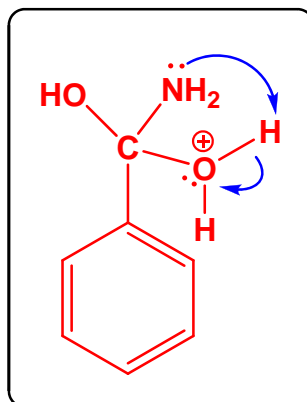
3) **Mechanism:** Provide a mechanism for the following transformation. Show all important flows of electrons, charges and intermediates. (15 pts)



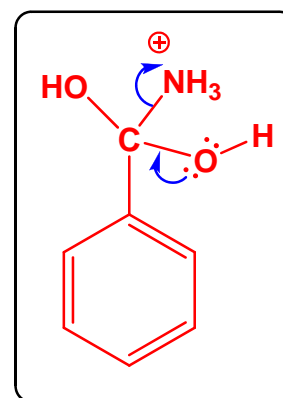
Protonated Amide-must show 3 resonance structures for full credit



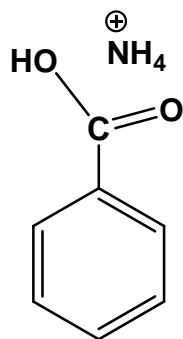
Water attacks-(use only one of the resonance structures)



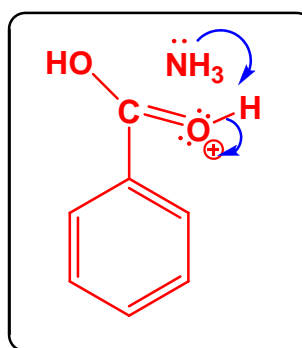
Intramolecular proton transfer



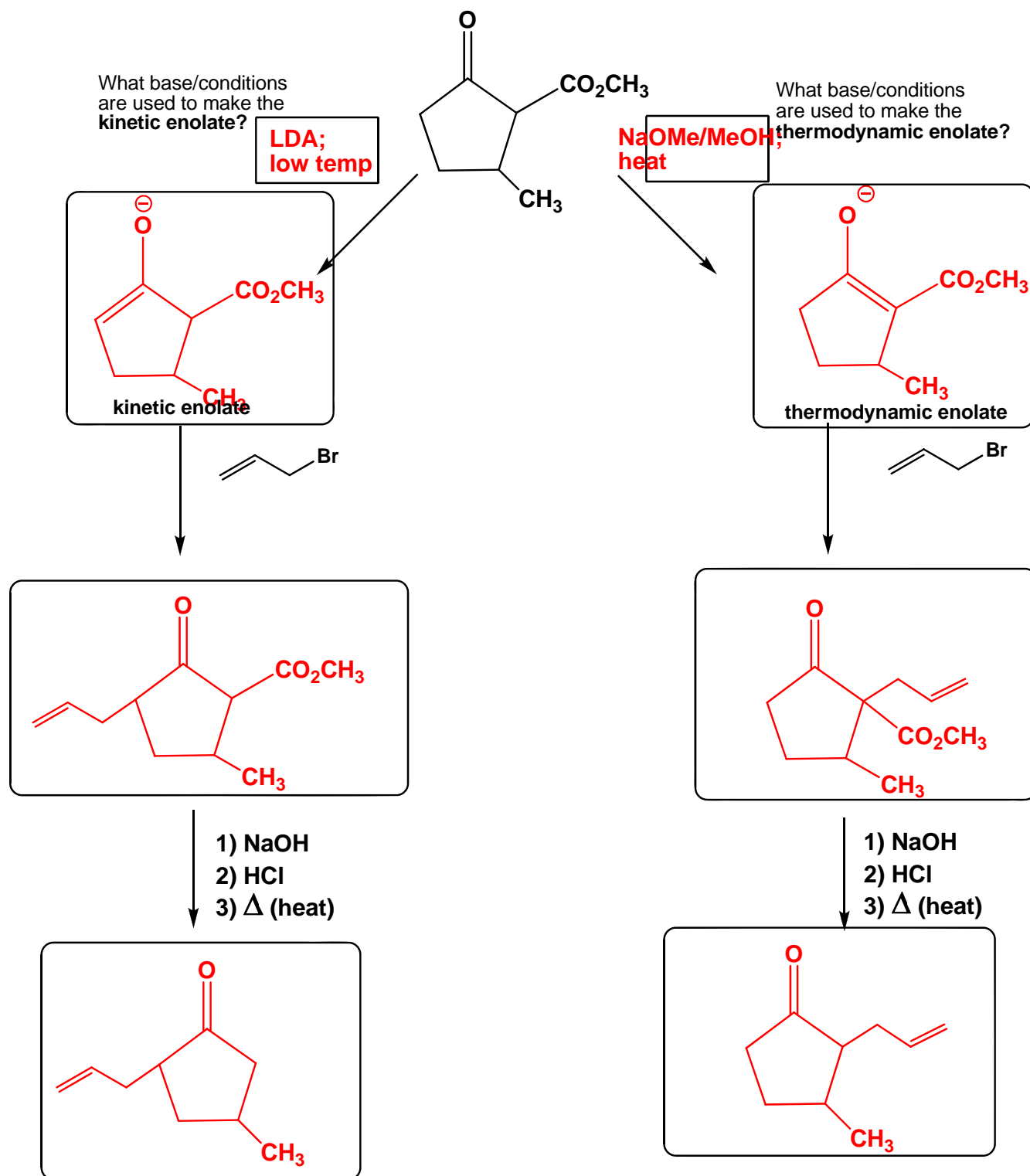
Elimination of ammonia



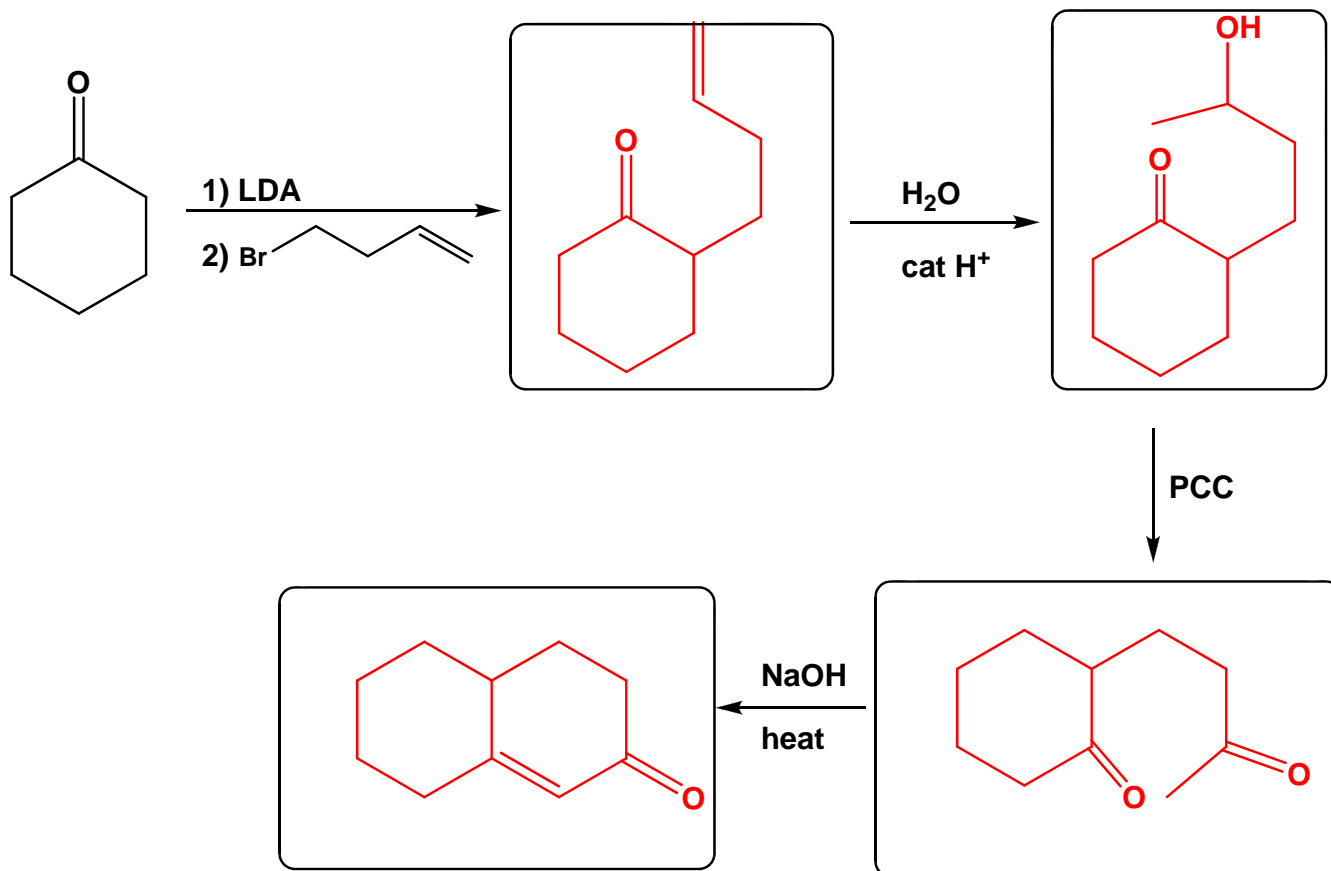
Acid Base reaction to give final products



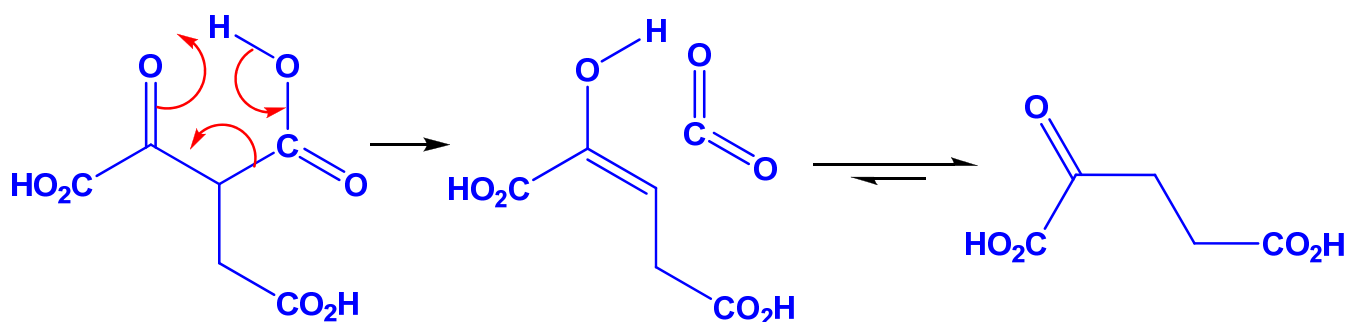
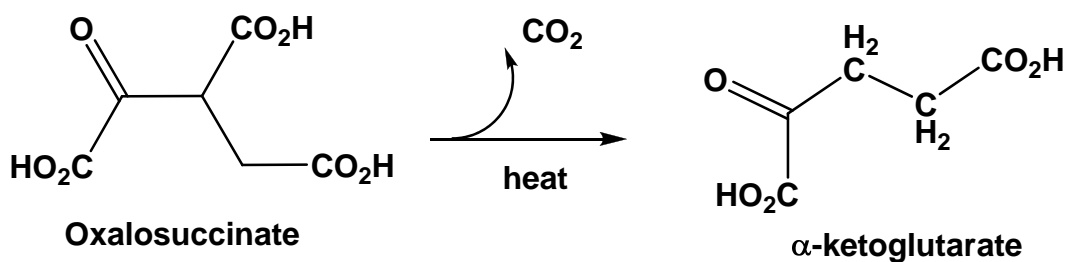
4) **Multi-step synthesis:** Follow the instructions for each pathway and provide the structure-in-a-box. (16 pts)



5) **Multi-step synthesis:** Provide the products in the following linear synthesis. (10 pts)



6) **Mechanism:** In the Krebs cycle (also known as the tricarboxylic acid cycle), oxalosuccinate undergoes decarboxylation to give α -ketoglutarate. In *vivo*, the reaction is enzyme catalyzed, but it is also a facile organic reaction. Show the mechanism, which accounts for the ease of the decarboxylation **and which carbon is lost**. (10 pts)



Hint: redraw Oxalosuccinate to show the favored \ddagger

END OF EXAM SECTION

LAST NAME:

FIRST NAME:

UTEID:

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 3

MWF 11 AM

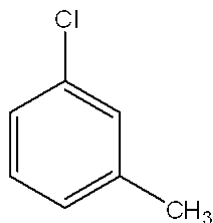
Question	Value	Score
1	7	
2	18	
3	16	
4	12	
5	14	
6	8	
Section II	75	
Section I	75	
Raw Total	150	
Grade		

CH310N-Exam III V 1.0

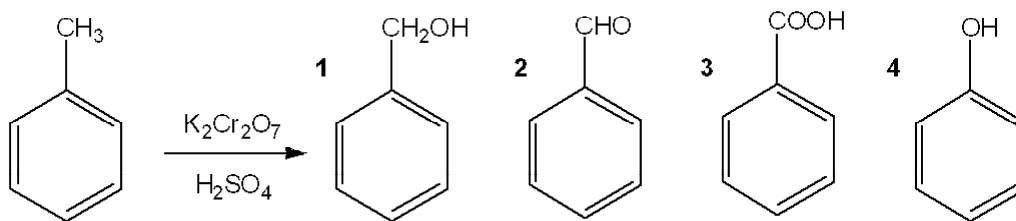
Objective Test Section

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. What are the relative positions of the substituents in the following structure?

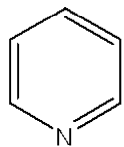


- a. para
b. anti
c. ortho
d. meta
2. Which of the following undergoes the most rapid acylation upon treatment with acetyl chloride and AlCl_3 ?
- a. 1,4-dichlorobenzene
b. toluene
c. benzene
d. chlorobenzene
3. Which of the following statements is *not* true about the structure of benzene?
- a. six atomic $2p$ -orbitals overlap to form six π -molecular orbitals
b. the bonds alternate in length around the ring
c. the ground state electronic configuration of benzene has six electrons in three π -bonding molecular orbitals
d. there are three bonding π -molecular orbitals and three π -antibonding molecular orbitals
4. What is the major organic product obtained from the following reaction?

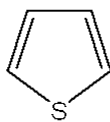


- a. **1**
b. **2**
c. **3**
d. **4**

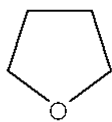
5. Which of the following heterocycles is *not* aromatic?



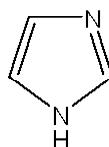
1



2



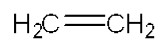
3



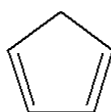
4

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

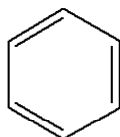
6. Which of the following molecules is the most acidic?



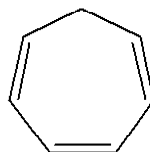
1



2



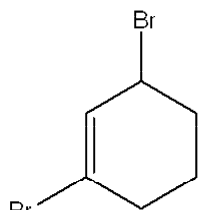
3



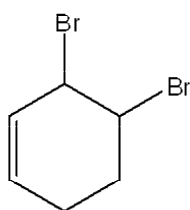
4

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

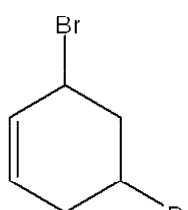
7. Which of the following is(are) formed upon addition of 1 mol of Br₂ to 1,3-cyclohexene?



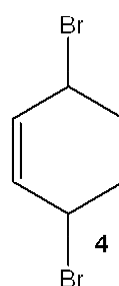
1



2



3



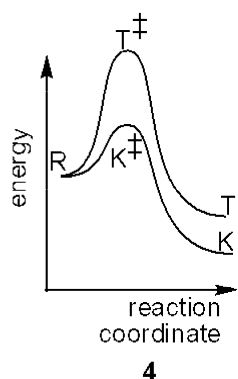
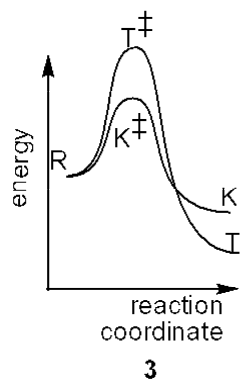
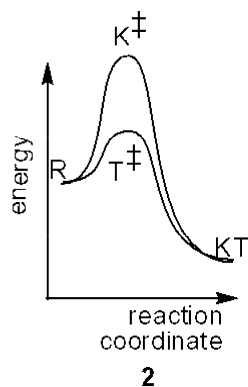
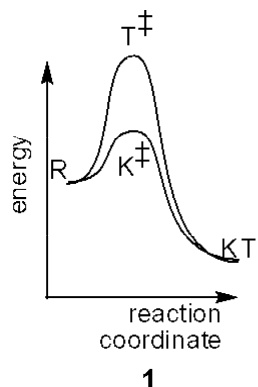
4

- a. only 2
- b. only 1 and 3
- c. only 2 and 4
- d. 1, 2 and 3

8. Which of the following undergoes the most rapid sulfonation upon treatment with fuming sulfuric acid?

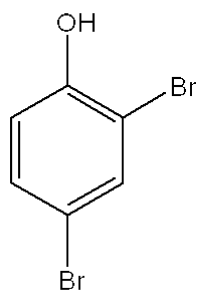
- a. benzoic acid
- b. nitrobenzene
- c. benzene
- d. benzonitrile

9. Which of the following reaction coordinate diagrams explains the formation of different thermodynamic (T) and kinetic products from the same reactants (R)?



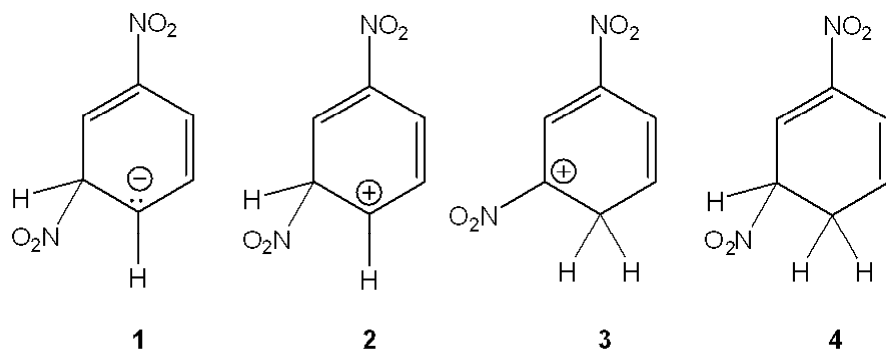
- a. 1
- b. 2
- c. 3
- d. 4

10. What is the IUPAC name of the following compound?

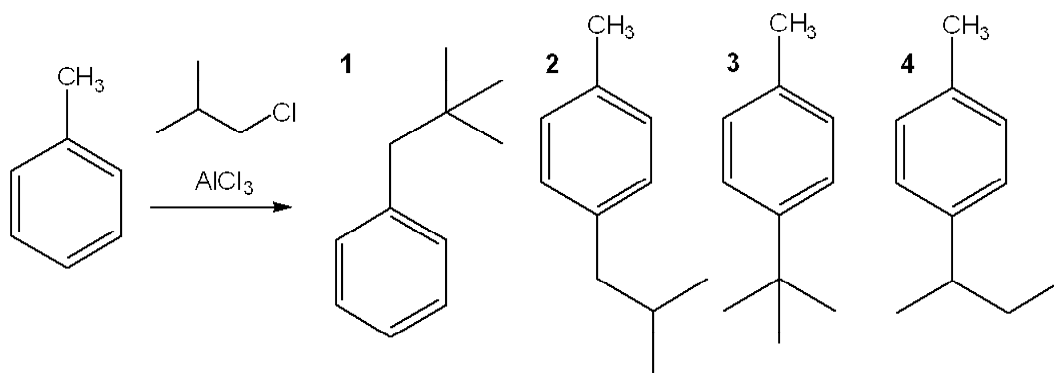


- a. 2,4-dibromotoluene
- b. 2,4-dibromohydroxybenzene
- c. 2,4-dibromophenol
- d. 4,6-dibromophenol

11. Which of the following is the reactive intermediate formed in the electrophilic nitration of nitrobenzene with HNO_3 and H_2SO_4 ?

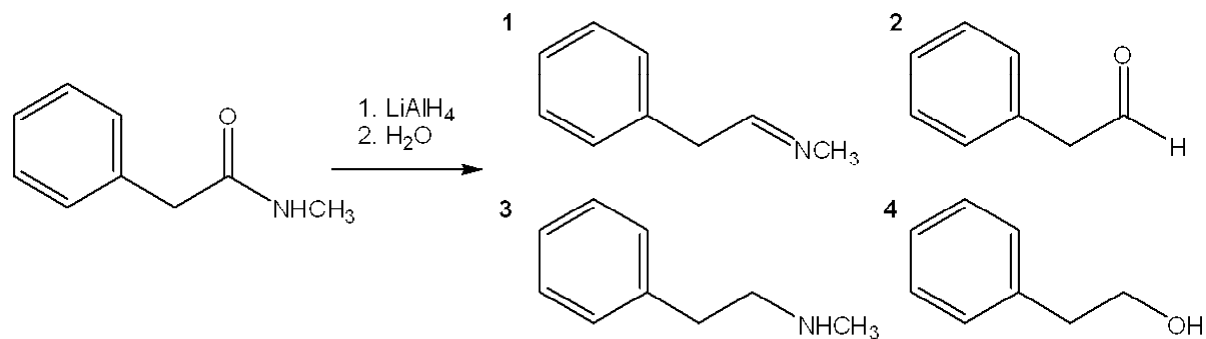


- a. **1**
 b. **2**
 c. **3**
 d. **4**
12. What is the electrophile in the reaction of benzene with acetyl chloride, CH_3COCl , and AlCl_3 ?
- a. CH_3CO_2^-
 b. $\text{CH}_3\text{C}\equiv\text{O}^+$
 c. benzene
 d. CH_3^+
13. What is the major organic product obtained from the following reaction?



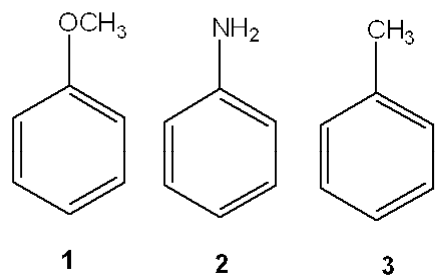
- a. **1**
 b. **2**
 c. **3**
 d. **4**
14. Which of the following is the weakest base?
- a. 4-methylaniline
 b. 4-nitroaniline
 c. 4-chloroaniline
 d. aniline

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



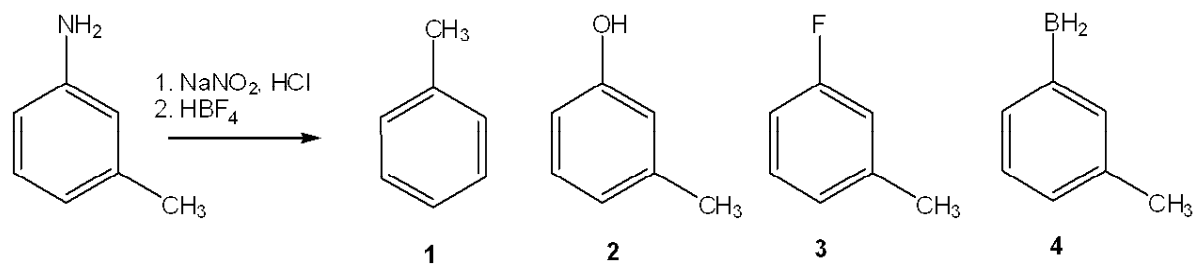
- a. **1**
- b. **2**
- c. **3**
- d. **4**

16. What is the correct assignment of the names of the following substituted benzenes?



- a. **1** = phenol; **2** = aniline; **3** = anisole
- b. **1** = anisole; **2** = xylene; **3** = toluene
- c. **1** = benzaldehyde; **2** = anisole; **3** = toluene
- d. **1** = anisole; **2** = aniline; **3** = toluene

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



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

18. Which of the following compounds are tertiary (3°) amines?

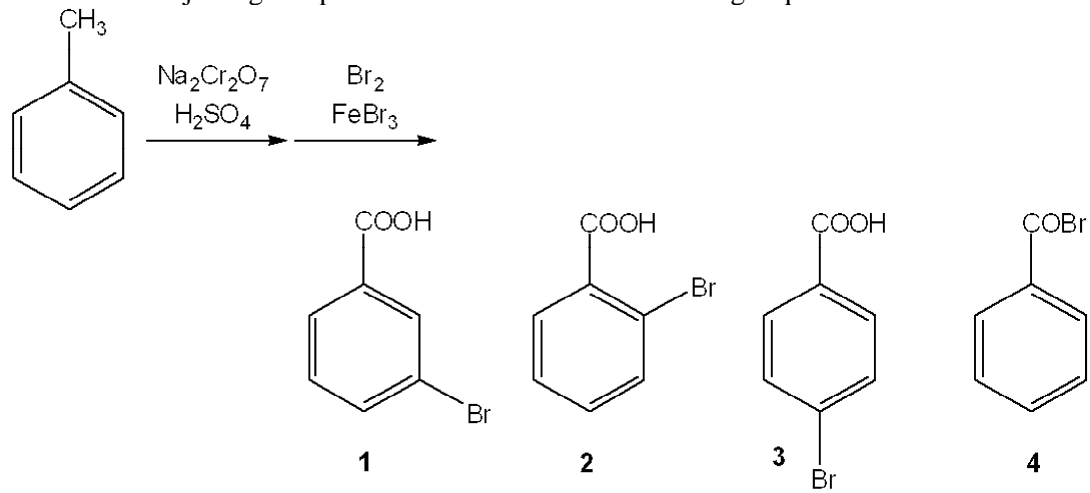
1. $(\text{CH}_3)_2\text{CHN}(\text{CH}_3)_2$
2. $\text{CH}_3\text{CH}(\text{CH}_3)\text{N}(\text{CH}_2\text{CH}_3)_2$
3. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHCH}_3$
4. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

- a. 1 and 2
- b. 1 and 3
- c. 1, 2 and 3
- d. 1, 2, 3 and 4

19. What is the reactive intermediate in the reaction of 1,3-butadiene with HBr resulting in 1,2-addition?

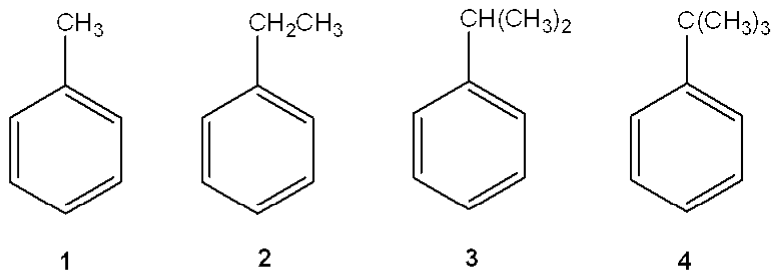
- a. cyclic bromonium cation
- b. dienophile
- c. allylic radical
- d. allylic cation

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



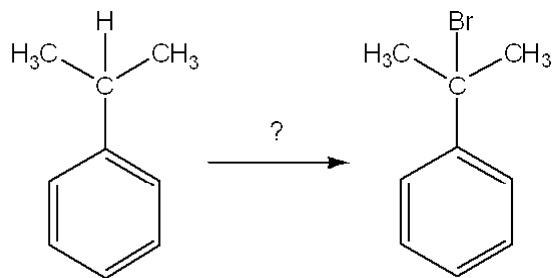
- a. 1
- b. 2
- c. 3
- d. 4

21. Which of the following does not undergo oxidation in the presence of H_2CrO_4 ?



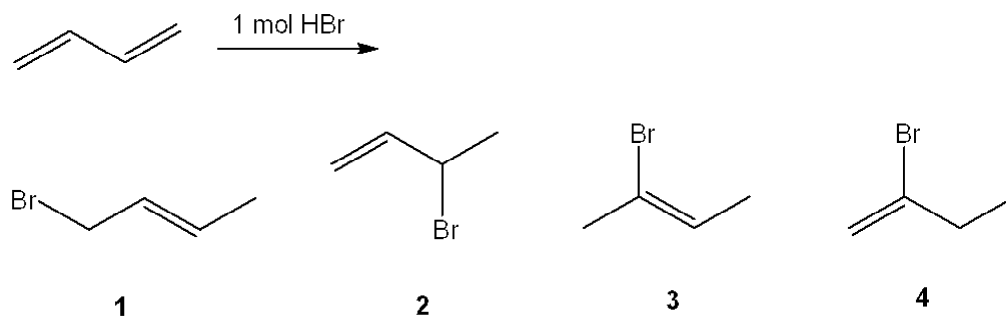
- a. 1
- b. 2
- c. 3
- d. 4

22. What is the best choice of reagent to achieve the following reaction?



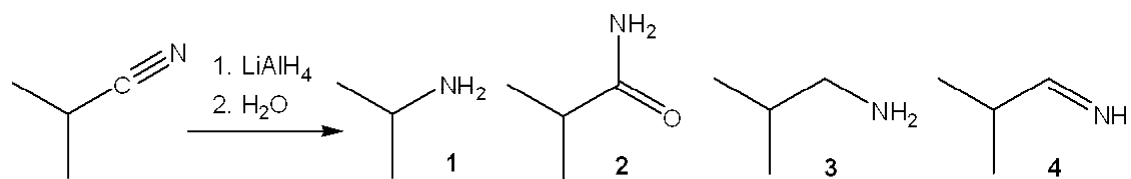
- a. NaBr
- b. $\text{HBr, H}_2\text{O}$
- c. $\text{Br}_2, \text{light}$
- d. $\text{Br}_2, \text{CCl}_4$

23. What is (are) the major organic product(s) formed in the following reaction?



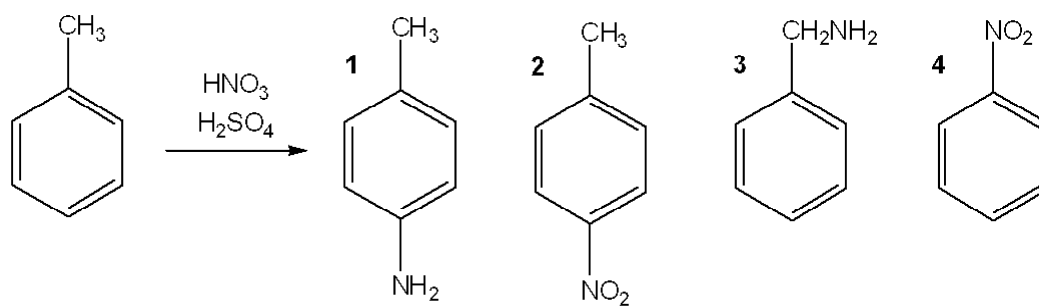
- a. only 1
- b. only 2
- c. only 1 and 3
- d. only 2 and 4

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



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

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



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

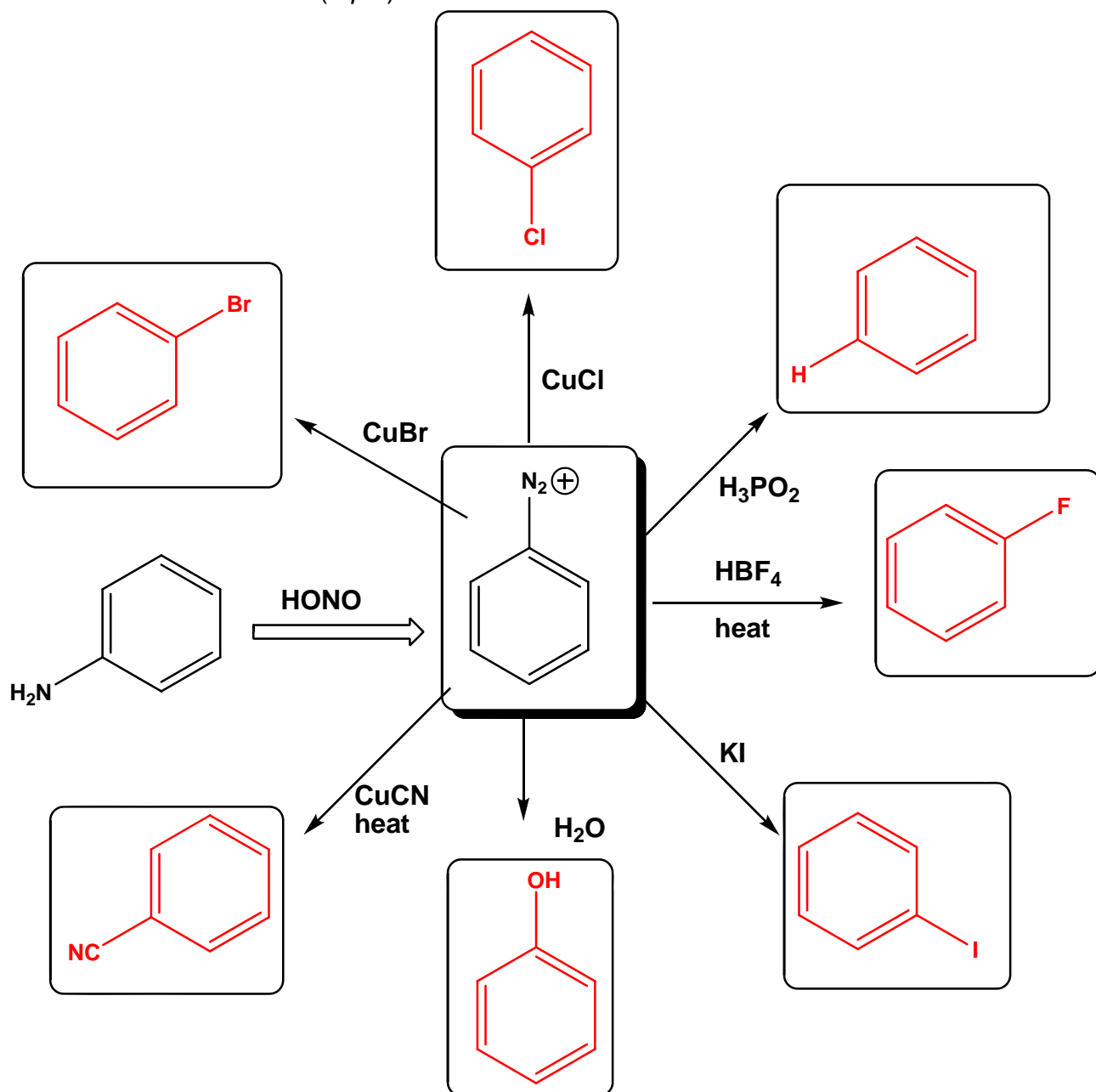
CH310N-Exam III V 1.0
Answer Section**MULTIPLE CHOICE**

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

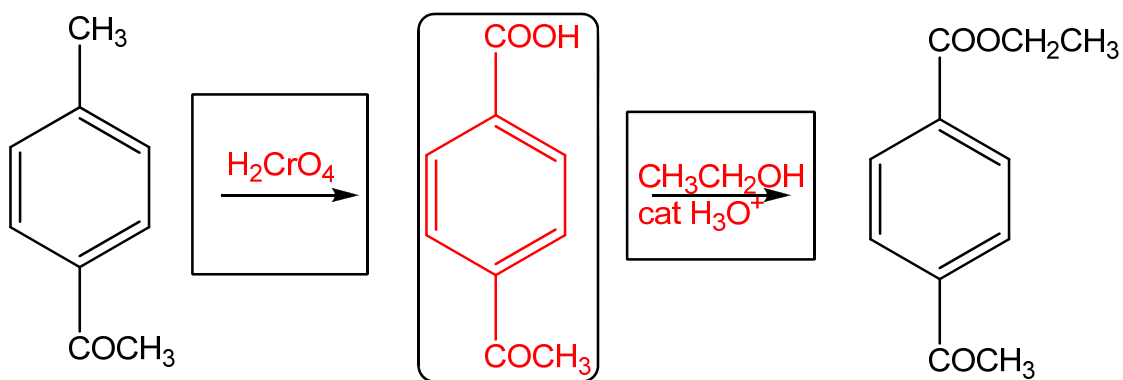
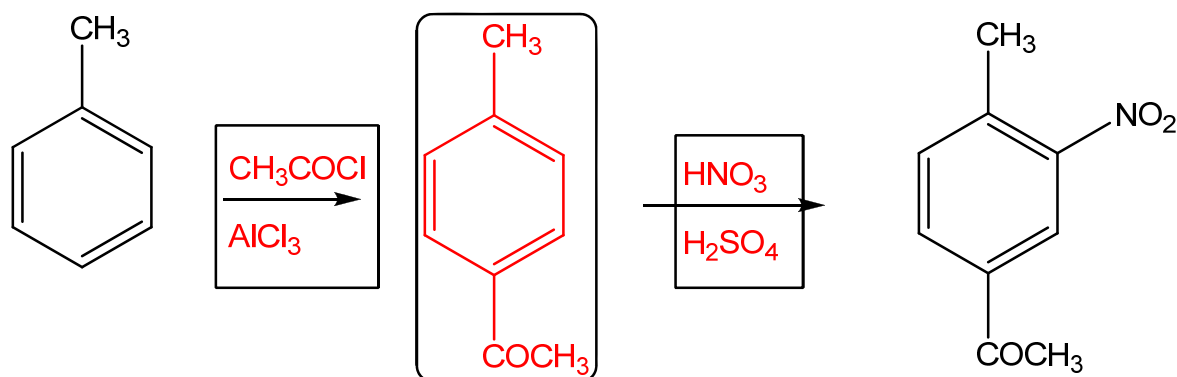
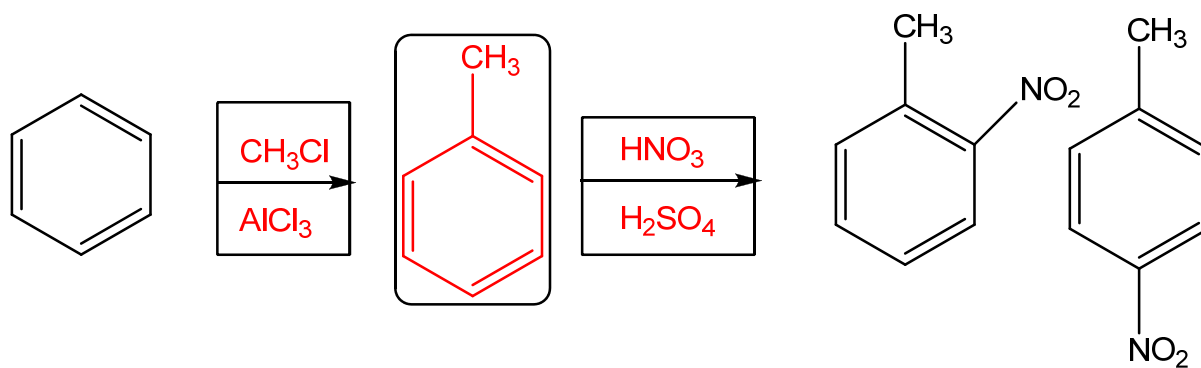
PART 2: Free Style Answer Format

(75 pts in this section)

1) Provide the products for the following reactions. This is not a mechanism question—simply write the structure-n-a-box. (7 pts)

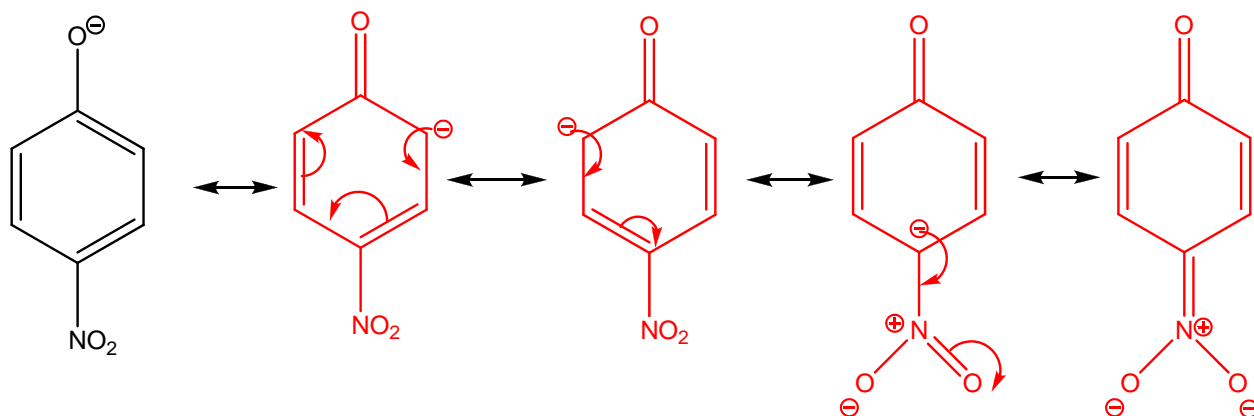


2) **Texas two step:** Each of these problems are two step synthesis of a product. In the boxes around the arrows, provide the reagents for the reaction; note that a hydrolysis step (e.g. to finish a Grignard reaction) may be required. In the rounded rectangle, draw the structure of the compound from the first reaction. (2 pts for reagents; 2 pts for structure-n-a-box)



3) **Resonance:** p-nitro phenol and m-nitro phenol are both acidic compounds, but one isomer is more acidic than the other. a) Draw the various resonance structures for each phenoxide anions. b) Predict which isomer is the more acidic and use the resonance structures to support your rationale. (16 pts)

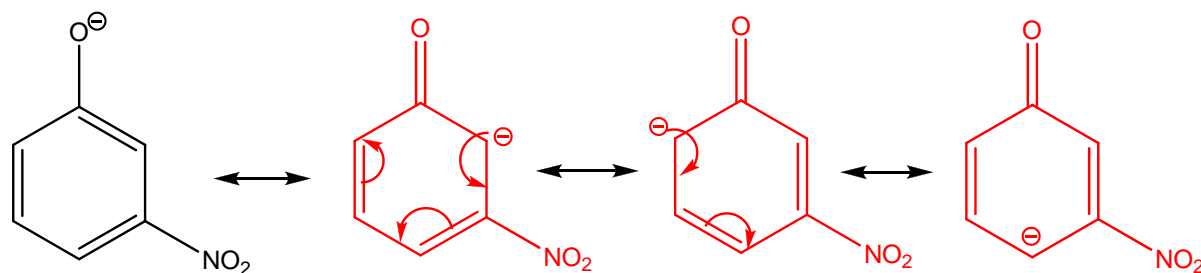
Draw the family of resonance structures for the p-nitrophenoxide:



This resonance structure show the stabilizing effect of the nitro group at the para position

pKa (p-nitrophenol)= 7.2
Stronger acid than m isomer

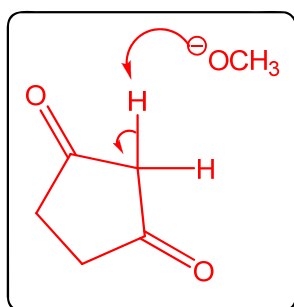
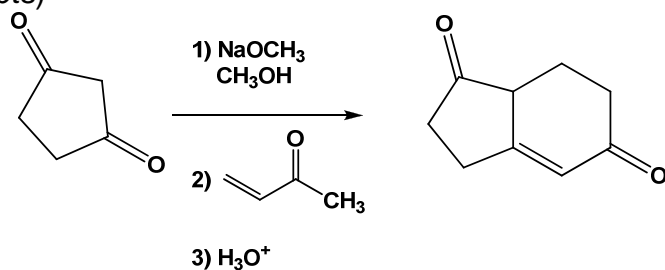
Draw the family of resonance structures for the m-nitrophenoxide:



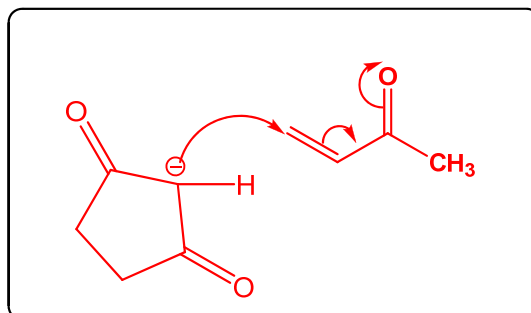
pKa (m-nitrophenol)= 8.4
Weaker acid than p isomer

This group of resonance structures shows that the nitro group has less stabilizing influence on the anion and therefore a lesser effect upon the acidity.

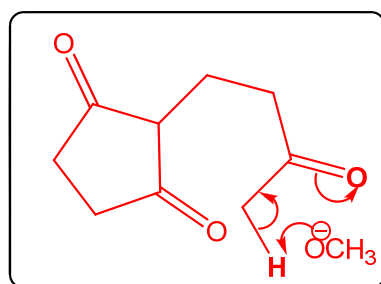
4) **Mechanism:** Provide a mechanism for the following transformation. Show all important flows of electrons, charges and intermediates. Where indicated, (in the structure boxes)- draw the intermediates. (12 pts)



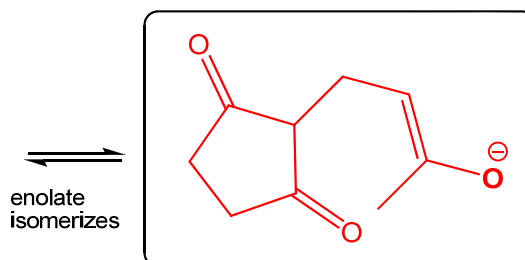
Deprotonation of the diketone



Show the addition to methyl vinyl ketone

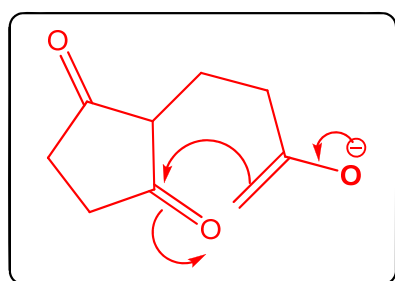


Show the deprotonation of a tri-ketone intermediate

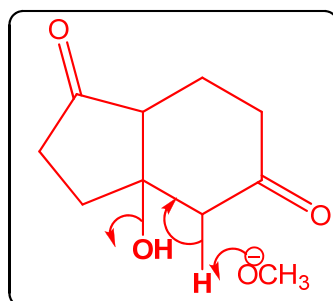


enolate isomerizes

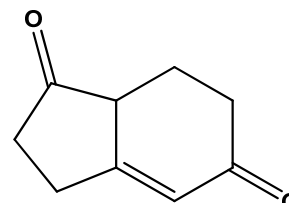
Draw the resulting enolate



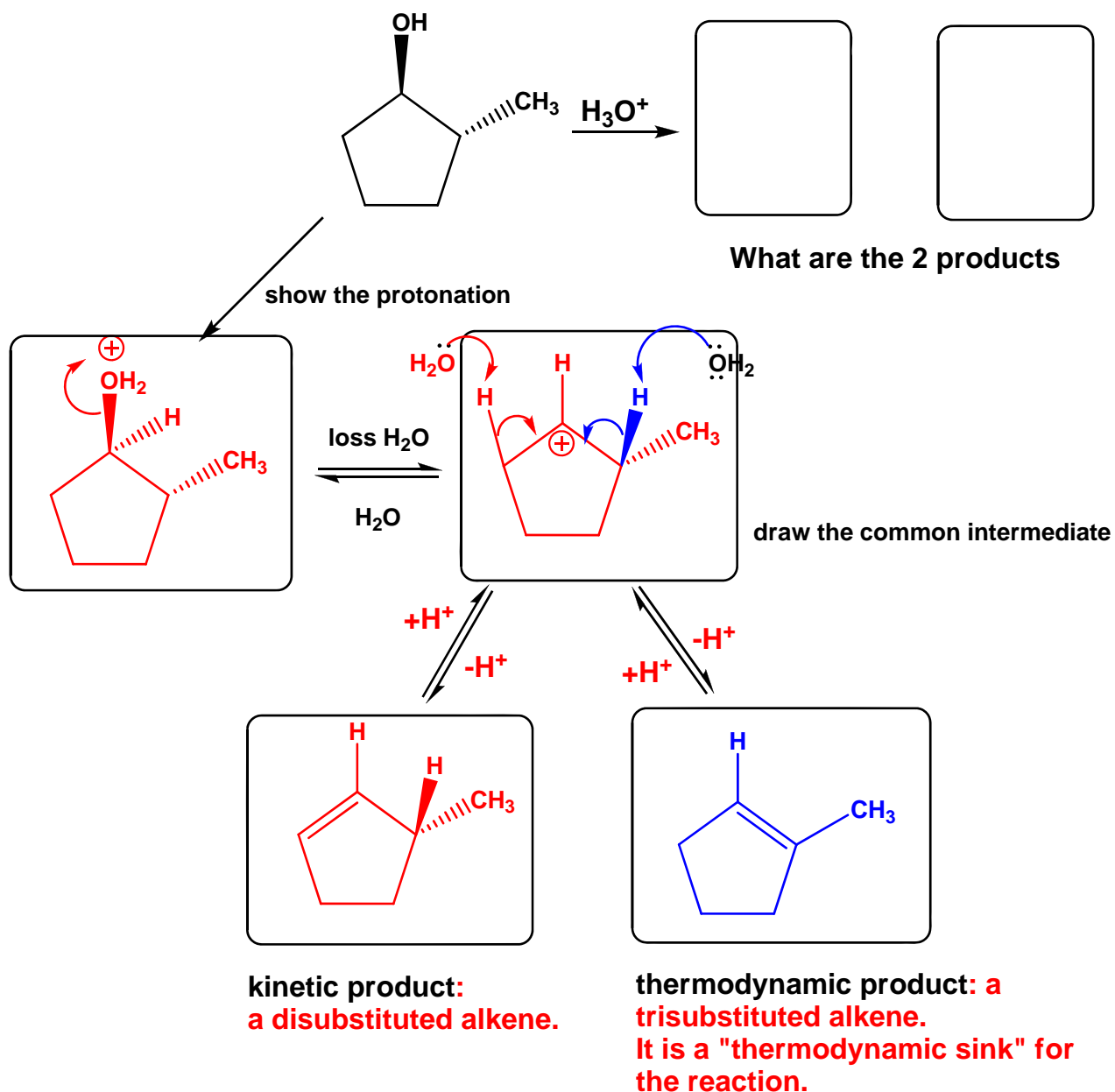
Draw the resulting enolate, & show the cyclization



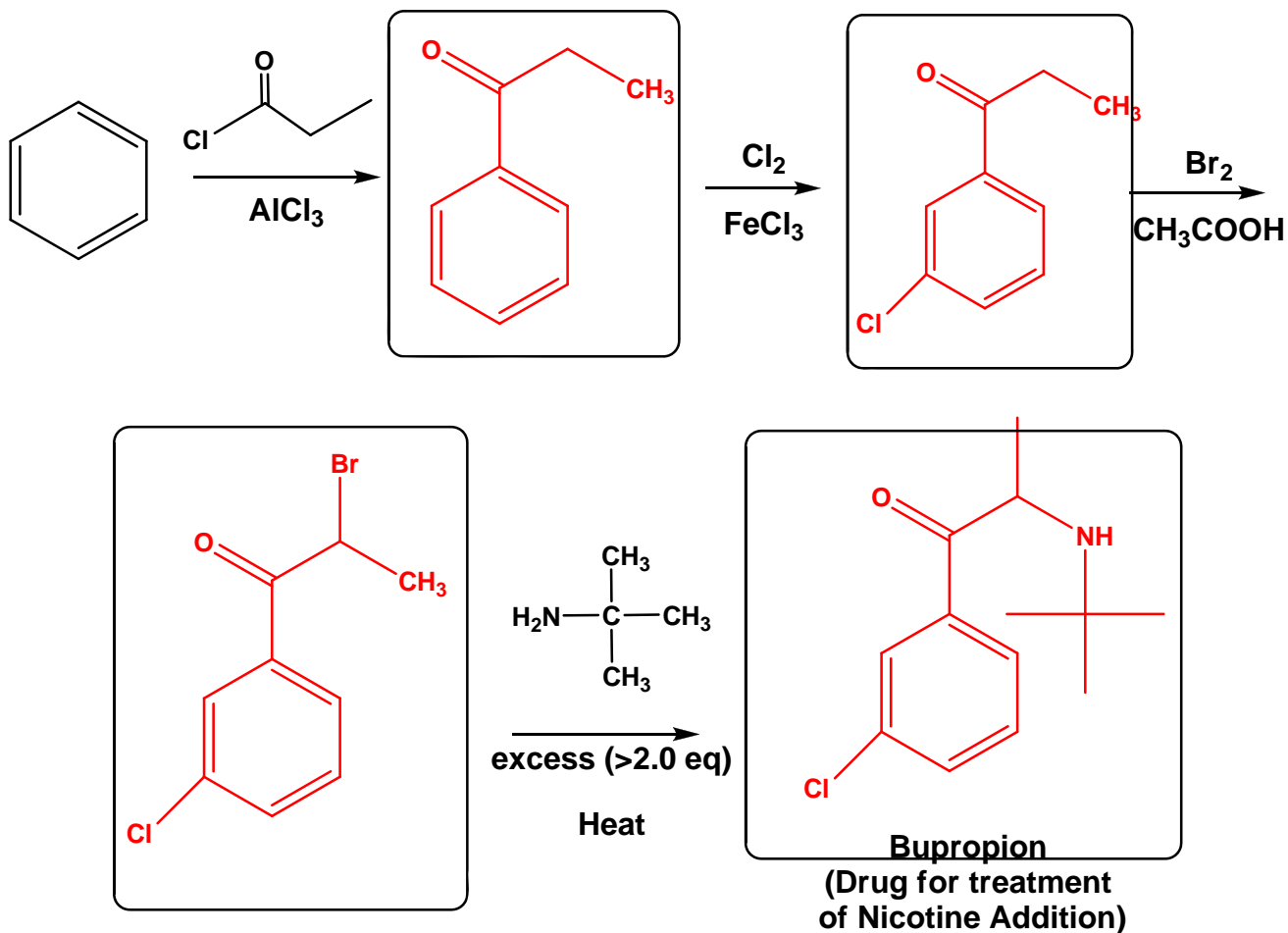
Show the dehydration of the β -hydroxy-ketone



5) **Kinetic/Thermodynamic Control:** When treated with acid & heat, trans-2-methylcyclopentanol will dehydrate to form two regioisomers. Follow the schemes & instructions below and show how each of these isomers are produced. (14 pts)



6) **Multi-step synthesis:** Provide the products for each of the reactions below. For full credit, show the relevant regiochemistry in the products. (8 pts)



END OF EXAM SECTION