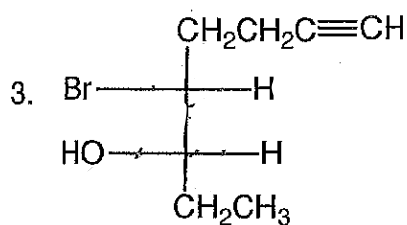
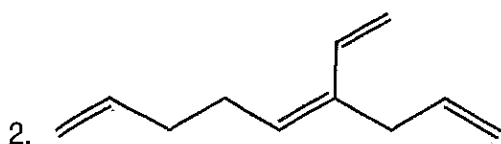
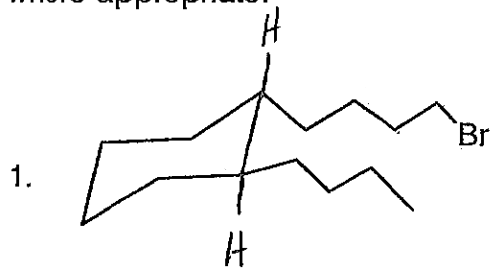


Final Exam F 2019

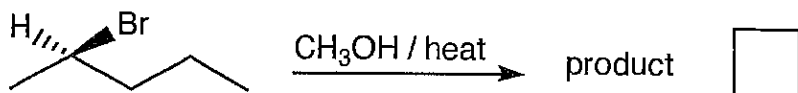
A. Nomenclature: (12 points)

Give an acceptable IUPAC name for each compound. Be sure to indicate the stereochemistry where appropriate.

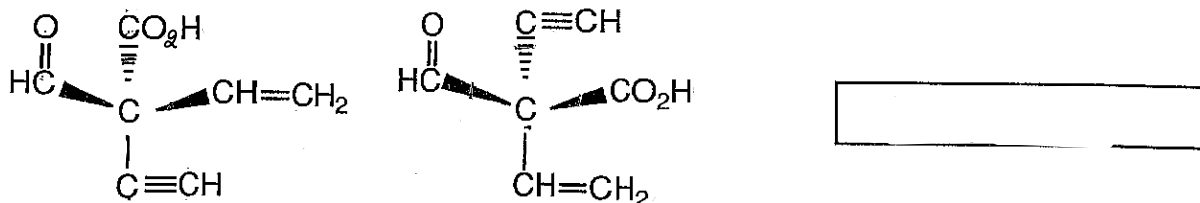


B. Facts: 24 points

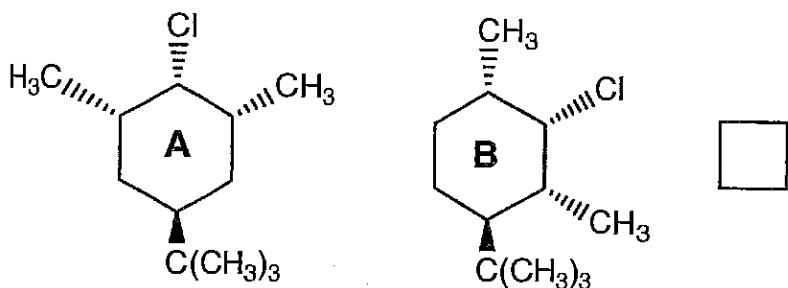
1. Will the product of the reaction below be optically active (**OA**) or optically inactive (**OI**)? (2 pts.)



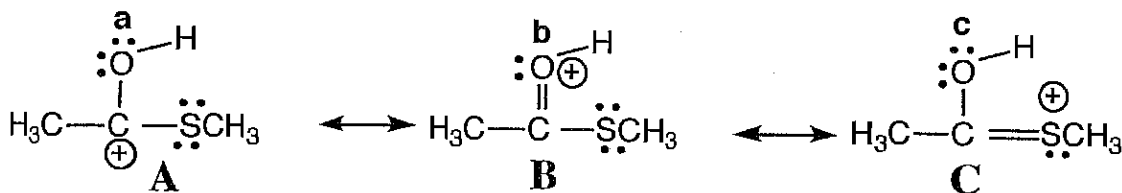
2. Label the following pair as identical, structural isomers, enantiomers or diastereomers. (2 pts.)



3. Consider the cyclohexane isomers below. Which isomer, **A** or **B**, would have a faster reaction rate in the E2 process? (2 pts.)



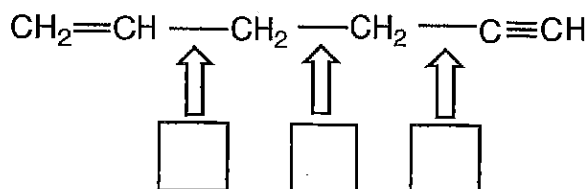
4. Consider the resonance contributors below.



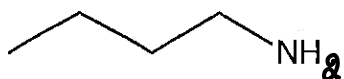
a. Place the letter of the major contributor in the box. (2 pts.)

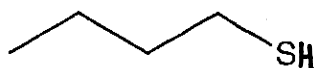
b. Place the hybridization of the oxygen atom labeled "a" in the box. (2 pts.)

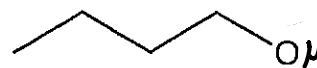
5. Place the indicated bonds in order of increasing carbon-carbon bond stretching frequency. (1=lowest frequency 3=highest frequency) (3 pts.)



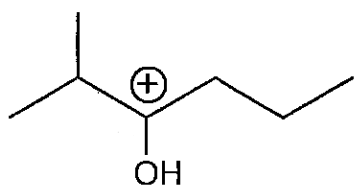
6. Place the compounds in order of increasing acidity. (1=least acidic, 3=most acidic) (3 pts.)

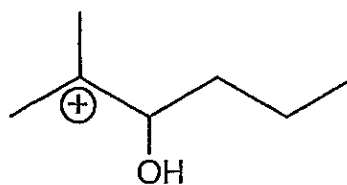




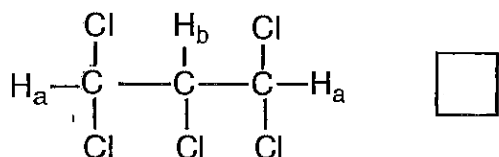


7. Place the cations in order of increasing stability. (1=less stable, 2=more stable) (2 pts.)

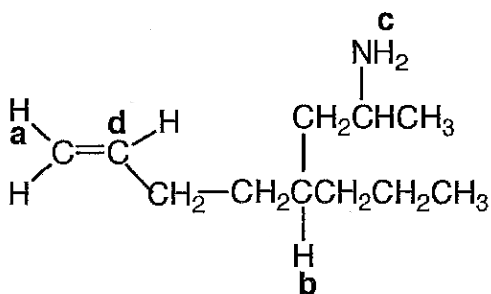




8. Is the signal for H_a or H_b more downfield in the 1H NMR spectrum of the compound below? (2 pts.)



9. Answer the following questions for the molecule shown below and place the answers in the appropriate boxes. (i) What are the theoretically predicted multiplicities (splitting patterns) of the signals for the protons labeled **a** and **b**? (ii) Under ultrapure conditions, what is the theoretically predicted multiplicity of the signal for the proton labeled **c**? (iii) What is the theoretically predicted multiplicity of the signal for the carbon atom labeled **d** in the proton spin coupled C-13 NMR?(4 pts.)



(i) multiplicity of H_a

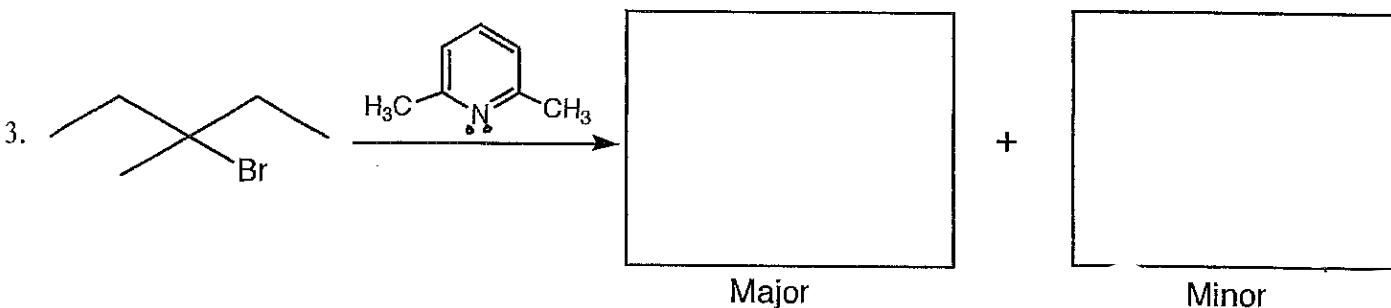
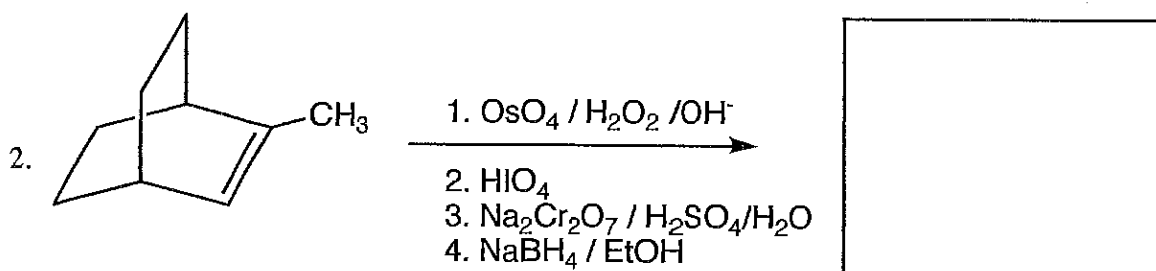
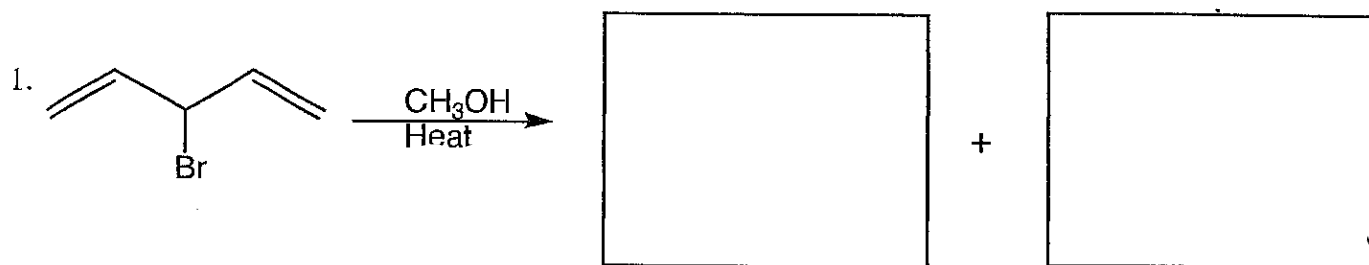
multiplicity of H_b

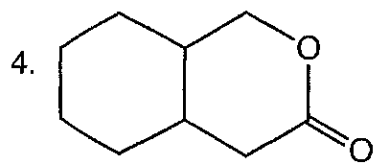
(ii) multiplicity of H_c

(iii) multiplicity of C_d

C. Reactions: Total = 36 points, 4 points each

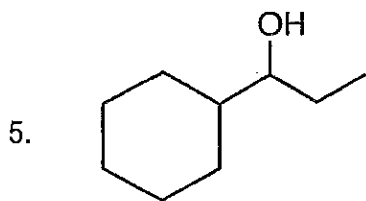
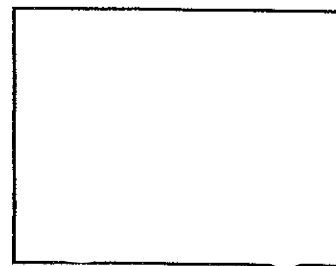
Please provide the major product in the answer box unless otherwise indicated. Indicate **stereochemistry** if applicable. **Full credit is awarded only when the product of each step in a multi-step reaction is shown below the reaction.**





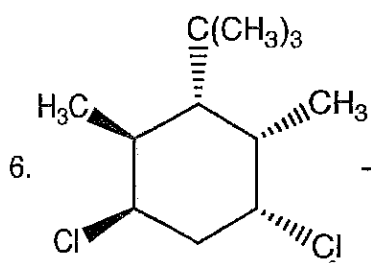
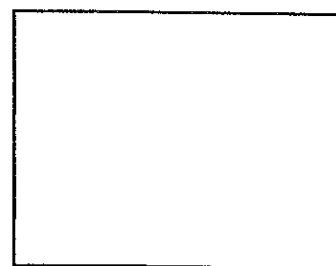
1. CH_3MgBr (xs), then H_3O^+

2. HBr / ether / 0°C

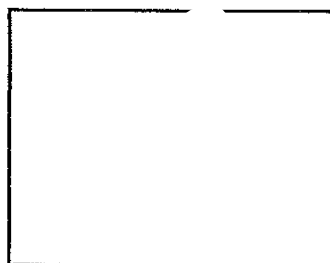


1. H_2SO_4 / heat

2. Br_2 / H_2O

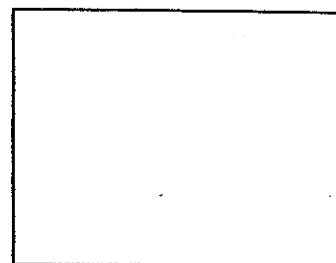


NaNH_2



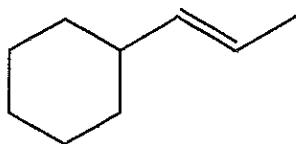
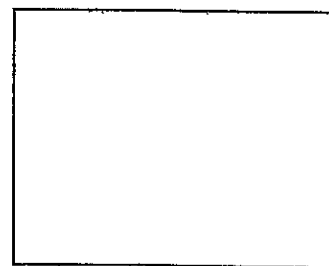
Major

+

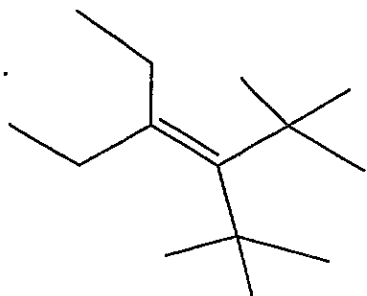


Minor

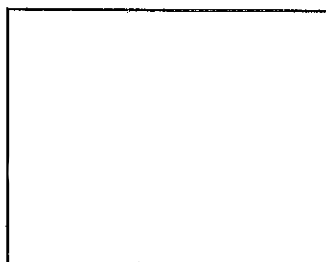
7.

1. $\text{Br}_2 / \text{CH}_2\text{Cl}_2$ 2. $\text{NaNH}_2 / 150\text{ }^\circ\text{C}$, then H_3O^+ 3. $\text{HgSO}_4 / \text{H}_2\text{SO}_4 / \text{H}_2\text{O}$ 

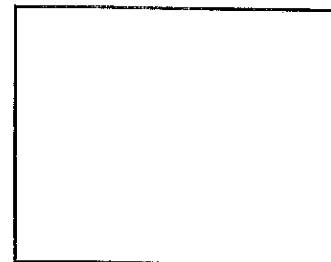
8.



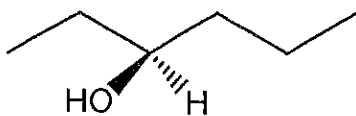
NBS / Light



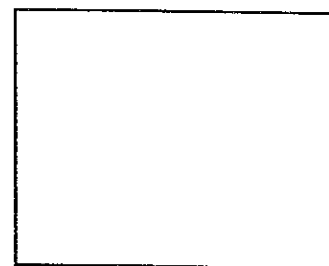
+



9.

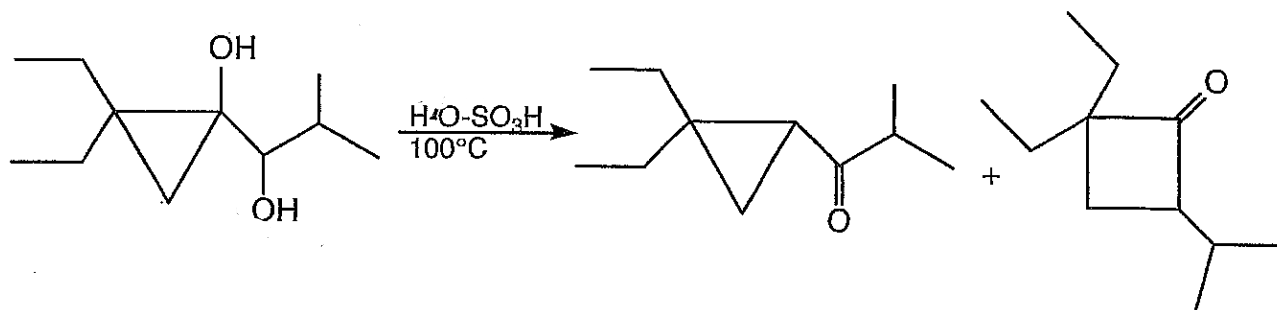


1. pTsCl / pyridine

2. $\text{CH}_3\text{S}^- \text{Na}^+ / \text{CH}_3\text{CN}$ 

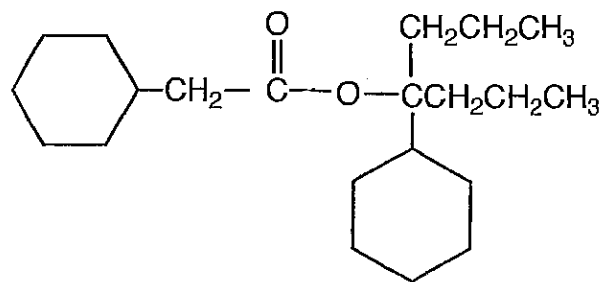
D. Mechanisms: (10 points)

The reaction below produces a mixture of products. Provide a clear mechanism to explain the formation of the products shown. Use curved arrows to indicate "electron flow". Remember to show only one step at a time. Show all intermediates and all formal charges. **If more than one resonance contributor is possible, be sure to show the more stable contributor.**



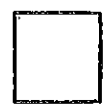
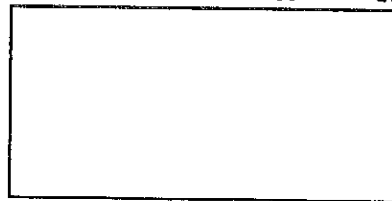
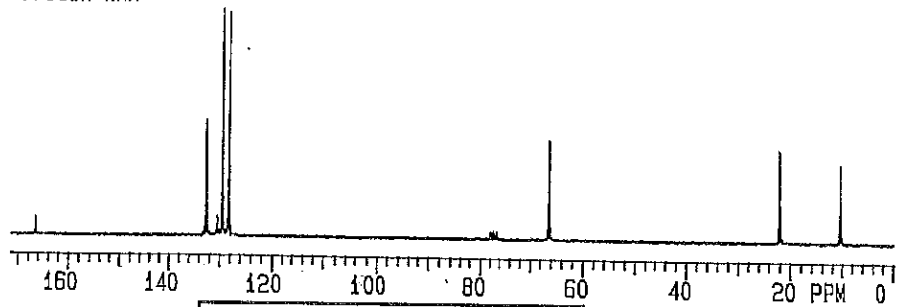
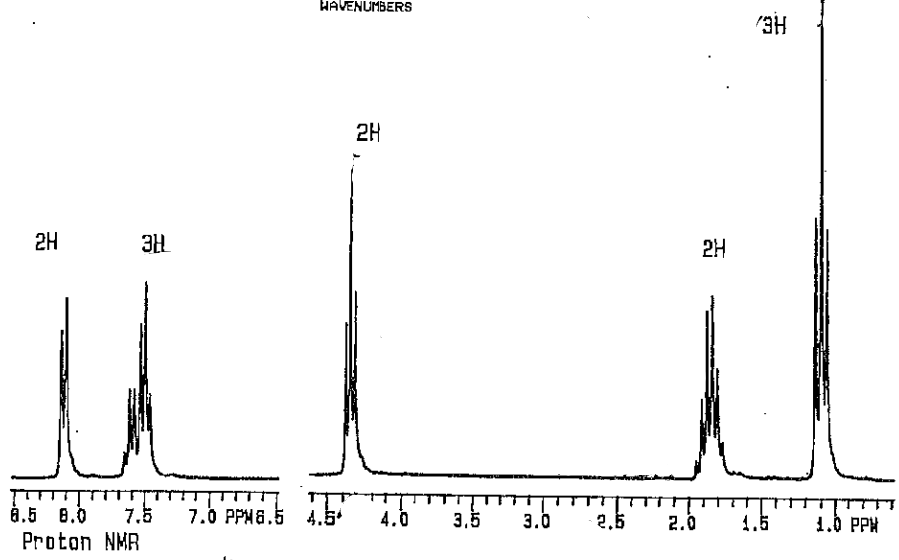
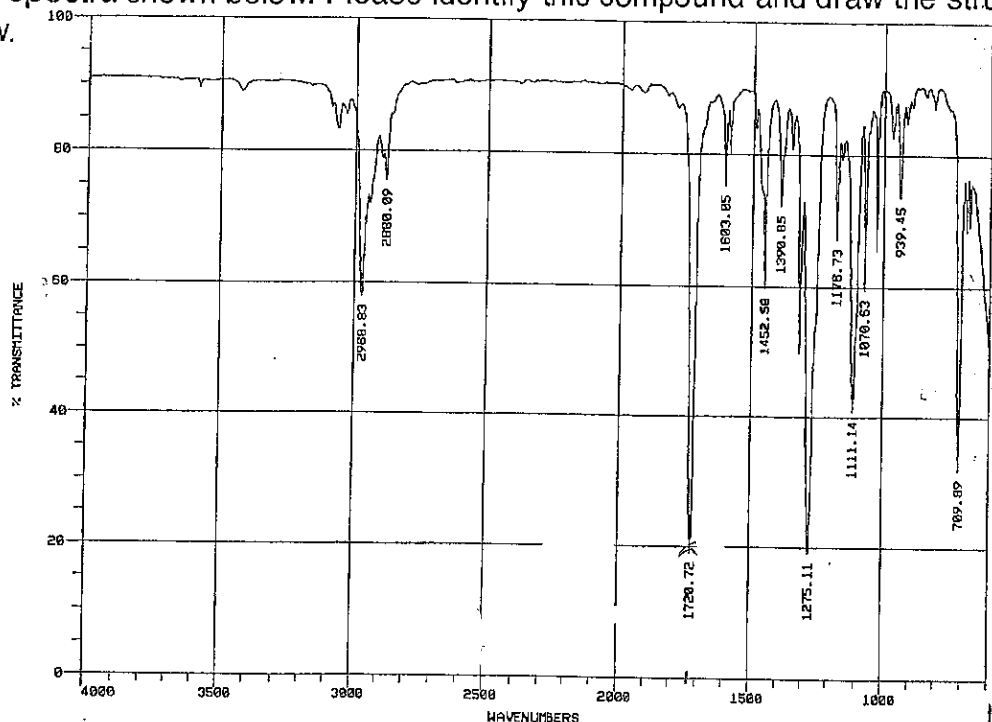
E. Synthesis: 10 Points

Synthesize the compound below using any of the following reagents: **cyclohexanol**, alcohols or alkenes of **four carbons or less**, any inorganic reagents, any peroxy acids, and any oxidizing or reducing agents.

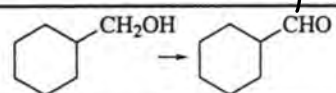


F. Spectroscopy: 8 Points

A compound with the formula $C_{10}H_{12}O_2$ exhibits the IR, 1H NMR, and proton-spin decoupled ^{13}C NMR spectra shown below. Please identify this compound and draw the structure in the box provided below.




OR-3. Which reagent will best accomplish this transformation?



(A) NaBH_4

(C) $\text{KMnO}_4(\text{aq}), \Delta$

(B) $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq}), \text{H}_2\text{SO}_4, \Delta$

(D)  CrO_3Cl^- (PCC)

SP-3. Signals from how many sets of protons would be observed in the ^1H NMR spectrum for this compound?



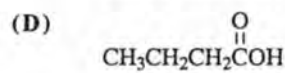
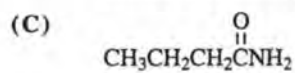
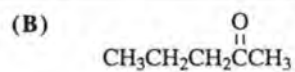
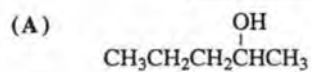
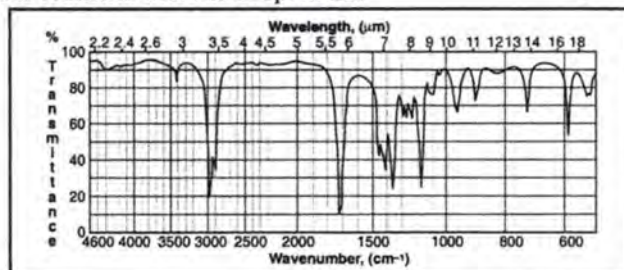
(A) 3

(B) 4

(C) 5

(D) 6

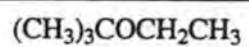
SP-2. Which compound is consistent with this IR spectrum?



SP-1. What effect does the conjugation of a carbonyl group with a carbon-carbon double bond have on the infrared absorption due to the C=O stretch?

- (A) It shifts to a lower frequency (longer wavelength).
- (B) It shifts to a higher frequency (shorter wavelength).
- (C) It has no effect.
- (D) The absorption due to the C=O stretch disappears.

24. Which reaction is *best* suited for the preparation of the ether shown?



- (A) $(\text{CH}_3)_3\text{CBr} \xrightarrow{\text{CH}_3\text{CH}_2\text{OK}}$
- (B) $\text{CH}_3\text{CH}_2\text{MgBr} \xrightarrow{(\text{CH}_3)_3\text{COH}}$
- (C) $\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{(\text{CH}_3)_3\text{COK}}$
- (D) $(\text{CH}_3)_3\text{CMgBr} \xrightarrow{\text{CH}_3\text{CH}_2\text{OH}}$