

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。


國立清華大學 109 學年度碩士班考試入學試題

系所班組別：生命科學院
丁組(醫學生物科技學程)

科目代碼：0706

考試科目：有機化學

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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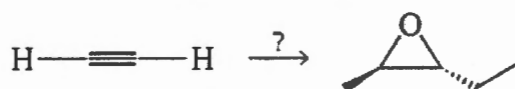
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

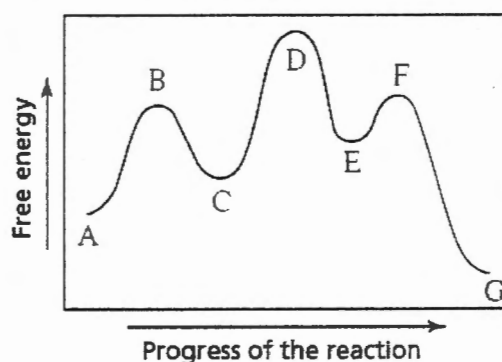
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Part 1 簡答題 (70%)

1. Show how the following compound can be prepared from the given starting material. Draw the structure of the compound that is formed in each step of the synthesis. (5%)



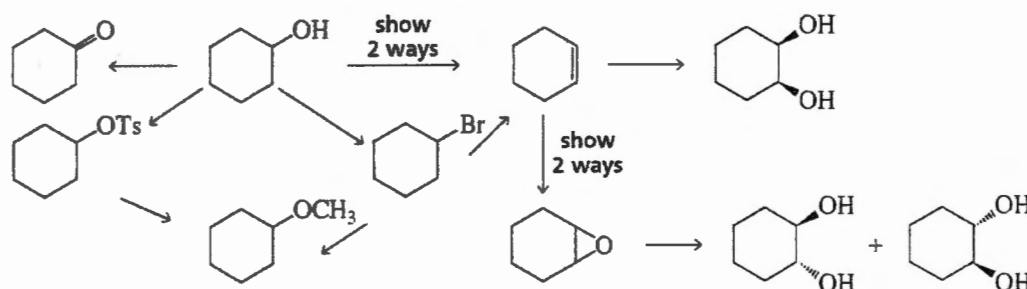
2. Given the reaction coordinate diagram for the reaction of A to form G, answer the following questions: (11%)



- How many intermediates are formed in the reaction?
- Which letters represent transition states?
- What is the fastest step in the reaction?
- Which is more stable: A or G?
- Does A or E form faster from C?
- Which is the more stable intermediate?
- What is the reactant of the rate-determining step?
- Is the first step of the reaction exergonic or endergonic?
- Is the overall reaction exergonic or endergonic?
- Which step in the forward direction has the largest rate constant?
- Which step in the reverse direction has the smallest rate constant?

3. Explain why 2,3-pentadiene is chiral. (4%)

4. Write the appropriate reagent over each arrow. (12%)



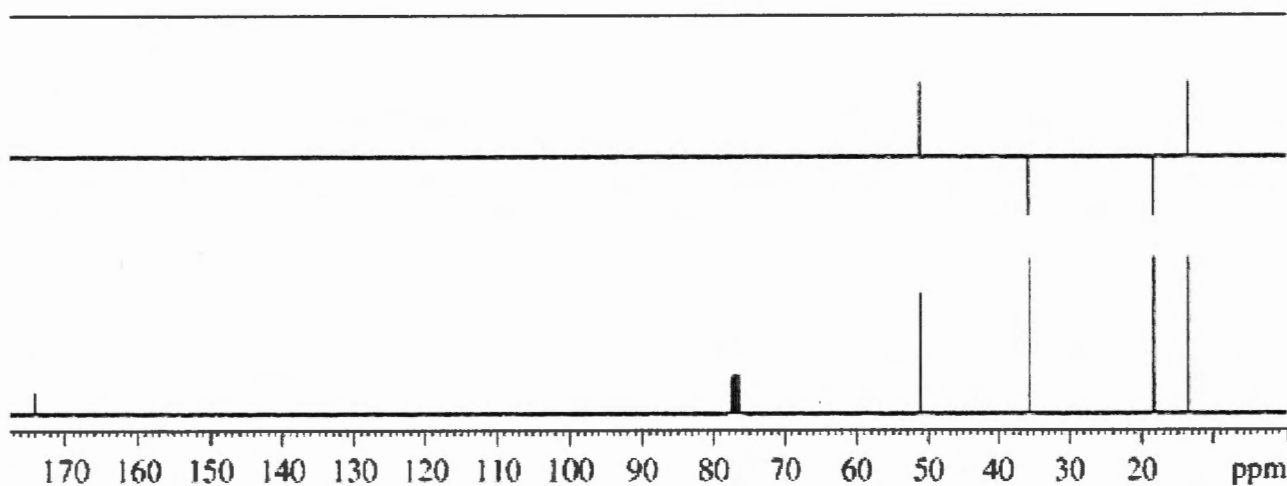
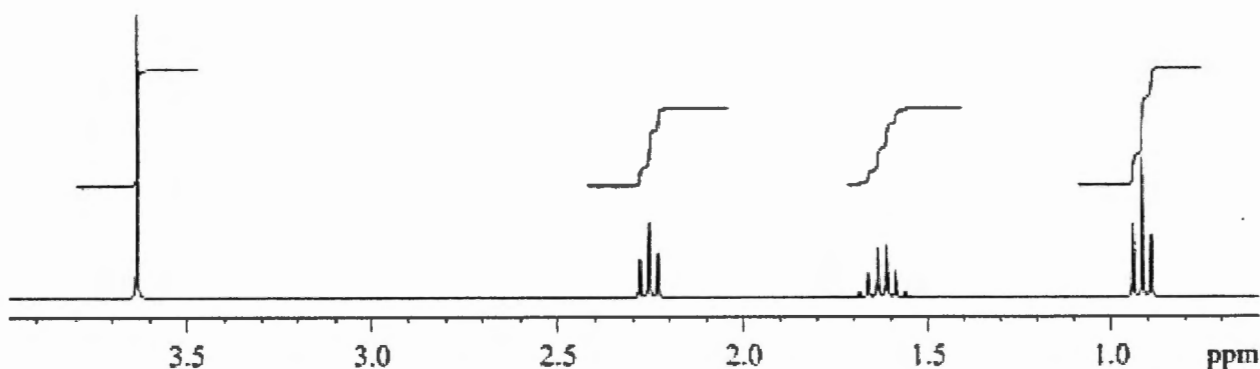
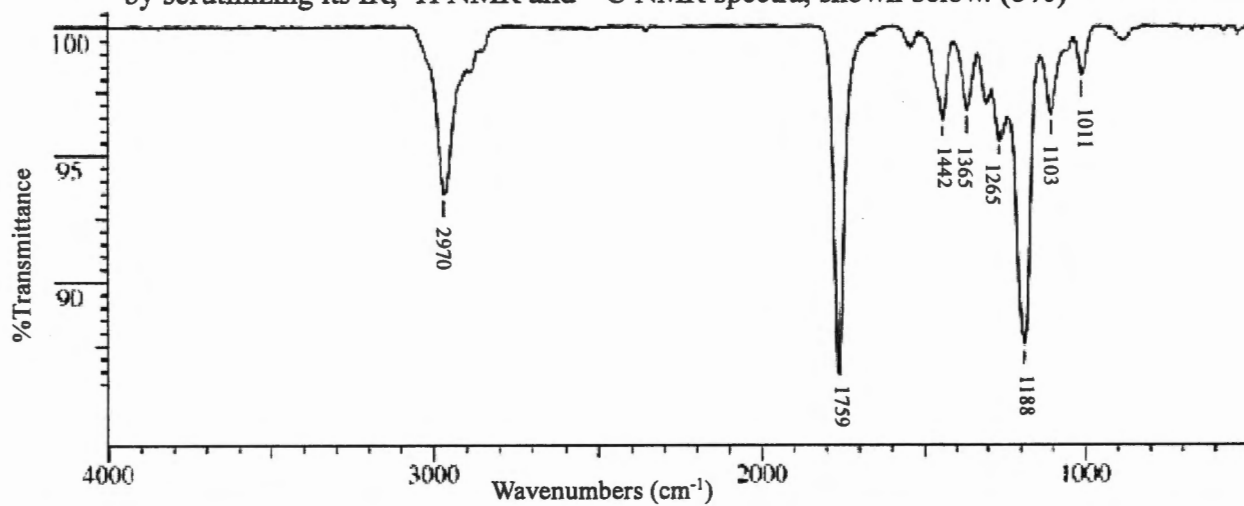
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共 11 頁，第 2 頁 *請在【答案卷】作答

5. An unknown compound, L, has the formula $C_5H_{10}O_2$. Elucidate the structure of L by scrutinizing its IR, 1H NMR and ^{13}C NMR spectra, shown below. (6%)



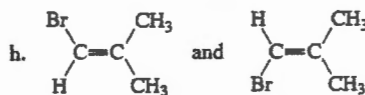
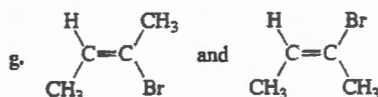
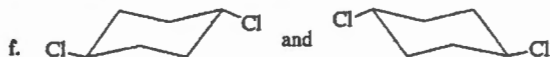
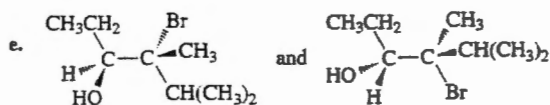
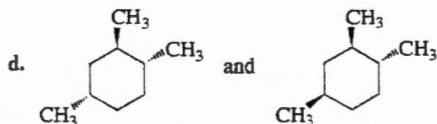
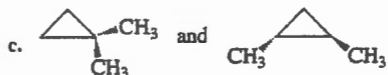
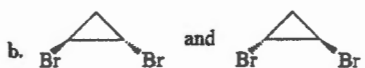
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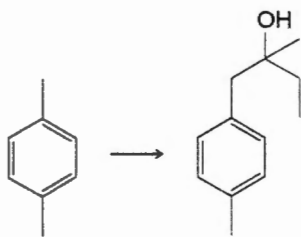
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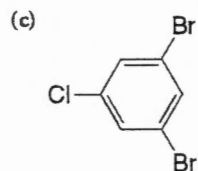
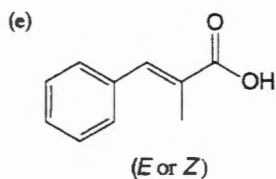
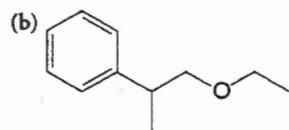
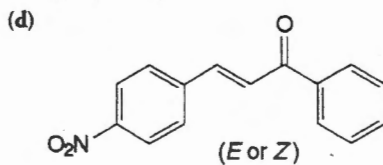
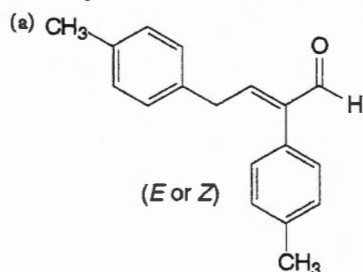
6. Are the following pairs identical, enantiomers, diastereomers, or constitutional isomers? (12%)



7. Indicate the reagents needed for the following multistep transformation. (5%)



8. Starting with benzene, toluene, or aniline and any other required reagents, outline a synthesis of each of the following: (15%)



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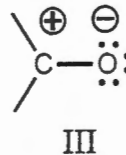
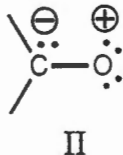
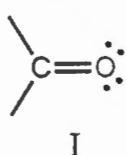
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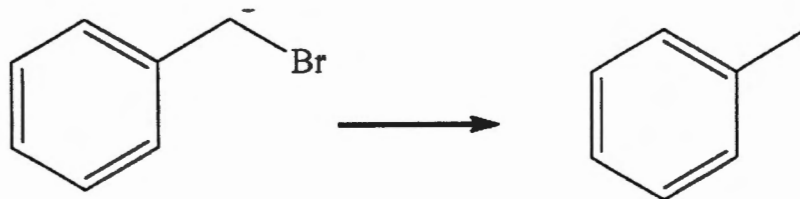
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Part 2 單選題 (30%, 1.5% each)

1. Which of the following resonance structures is not a significant contributor to the hybrid for the carbonyl group?



- a) I
b) II
c) III
d) Neither II nor III is important.
e) All are significant contributors.
2. The following transformation would be considered a(n)?



- a) Reduction
b) Oxidation
c) Addition
d) Elimination
e) Rearrangement
3. Which of these molecules is not expected to arise as a product of the high temperature chlorination of methane?
- a) CCl_4
b) HCCl_3
c) CH_2Cl_2
d) CH_3CH_3
e) $\text{CH}_2=\text{CH}_2$

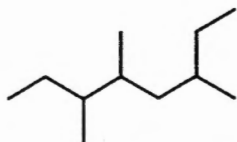
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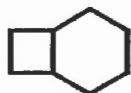
*請在【答案卷】作答



4. The IUPAC name for is:

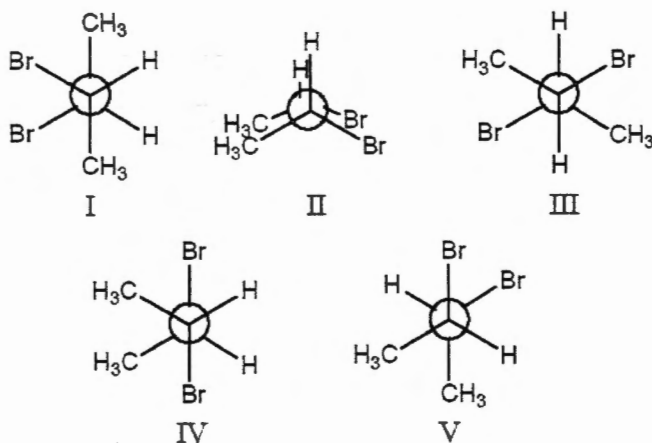
- 6-Ethyl-3,4-dimethylheptane
- 2-Ethyl-4,5-dimethylheptane
- 3,4,6-Trimethyloctane
- 3,5,6-Trimethyloctane
- 2-(1-Methylpropyl)-4-methylhexane

5. What is the name of this compound?



- Bicyclo[2.2.2]octane
- Bicyclo[3.2.1]octane
- Bicyclo[4.1.1]octane
- Bicyclo[4.2.0]octane
- Bicyclo[3.3.0]octane

6. The most stable conformation of 2,3-dibromobutane, viewed through the C-2—C-3 bond :



- I
- II
- III
- IV
- V

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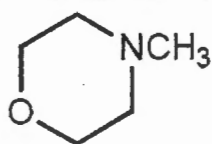
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共 11 頁，第 6 頁 *請在【答案卷】作答

7. Which of the following compounds contains polar covalent bonds?

- a) CS₂
- b) LiF
- c) F₂
- d) CH₃F
- e) None of these choices.

8. What functional group(s) is/are present in the following compound?

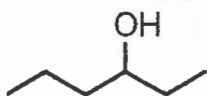


- a) ether and 2° amine
- b) ester and 3° amine
- c) 3° amine
- d) 3° amine and ether
- e) None of these choices.

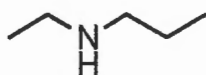
9. Which compound would have the highest boiling point?

- a) CH₃CH₂CH₂CH₂CH₂CH₃
- b) CH₃CH₂OCH₂CH₂CH₃
- c) CH₃CH₂CH₂CH₂CH₂OH
- d) CH₃CH₂OCH(CH₃)₂
- e) CH₃OCH₂CH₂CH₂CH₃

10. The IR spectrum of which of the following substances is likely to show a small, but sharp peak at 2200 cm⁻¹?



I



II



III



IV



V

- a) I
- b) II
- c) III
- d) IV
- e) V.

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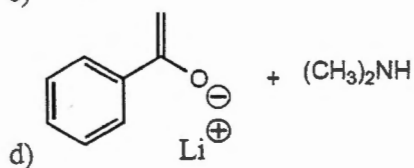
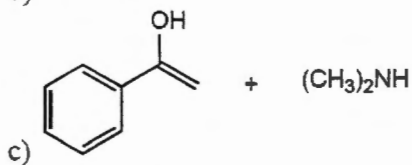
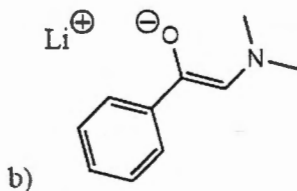
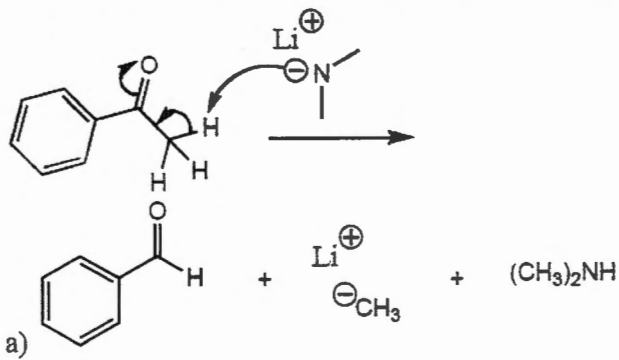
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*請在【答案卷】作答

11. What is the conjugate base of ethanol?

- a) $\text{CH}_3\text{CH}_2\text{O}^-$
- b) CH_3CH_2^-
- c) $\text{CH}_3\text{CH}_2\text{OH}_2^+$
- d) CH_3CH_3
- e) CH_3OCH_3

12. What is/are the product(s) of the following acid-base mechanism?



e) None of these choices.

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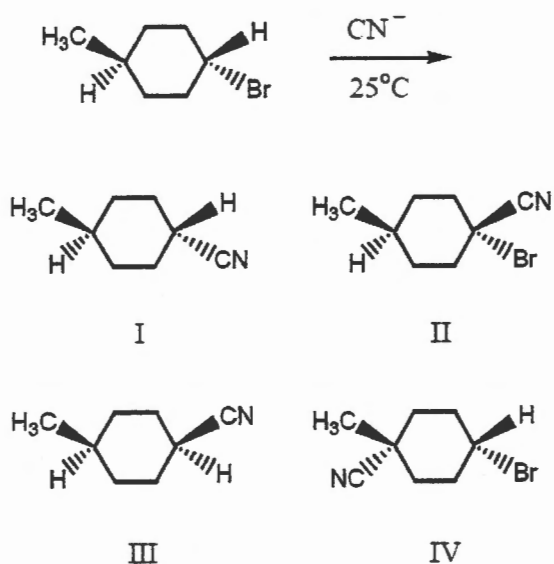
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13. In the molecular orbital model of the cyclobutadiene, how many pairs of degenerate π -bonding molecular orbitals are there?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 0

14. What would be the major product of the following reaction?



- a) I
- b) II
- c) III
- d) IV
- e) Equal amounts of I and III.

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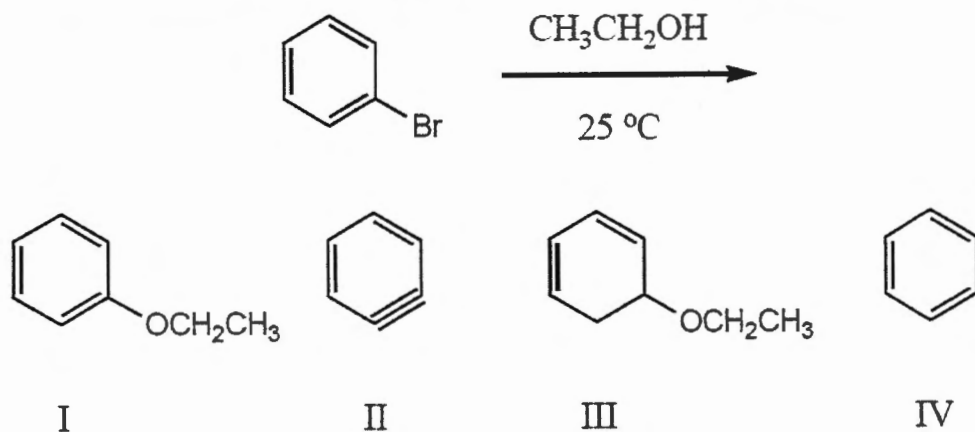
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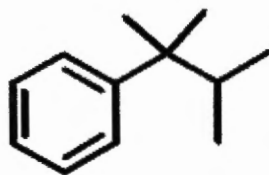
*請在【答案卷】作答

15. What would be the major product(s) of the following reaction?



- a) I
- b) II
- c) III
- d) IV
- e) None of these choices.

16. Predict the splitting pattern you would observe for the proton at C1 of 2,3-dimethyl-2-phenylbutane.



- a) Doublet
- b) Singlet
- c) Quartet
- d) Septet
- e) Octet

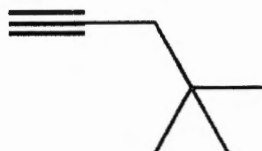
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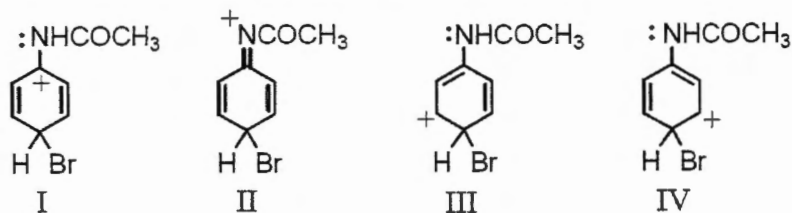
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17. For the following compound how many different signals would you see in the proton NMR? (Assume that you can see them all.)



- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

18. Which of the following structures contribute(s) to the resonance hybrid of the intermediate formed when acetanilide undergoes para-bromination?



- a) I
- b) II
- c) III
- d) IV
- e) All of these choices.

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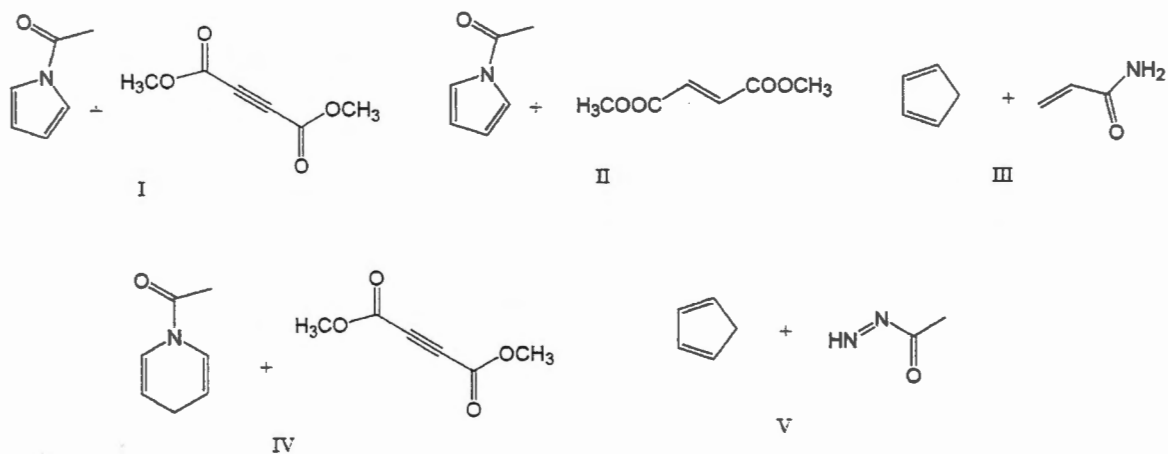
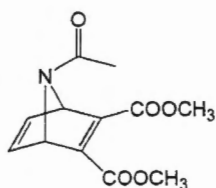
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19. The electrophilic bromination or chlorination of benzene requires, in addition to the halogen:

- a) a hydroxide ion.
- b) a Lewis base.
- c) a Lewis acid.
- d) peroxide.
- e) ultraviolet light.

20. Which of the following pairs of compounds could be used as the basis for a Diels-Alder synthesis of the compound shown below?



- a) I
- b) II
- c) III
- d) IV
- e) V