

國立清華大學 103 學年度碩士班考試入學試題

系所班組別：生命科學院乙組、醫學生物科技學程

考試科目（代碼）：有機化學(0502、0706)

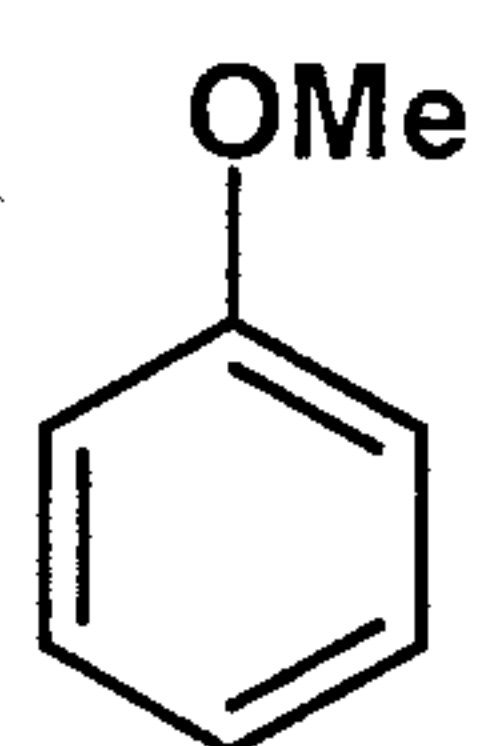
共 10 頁，第 1 頁

*請在【答案卷】作答

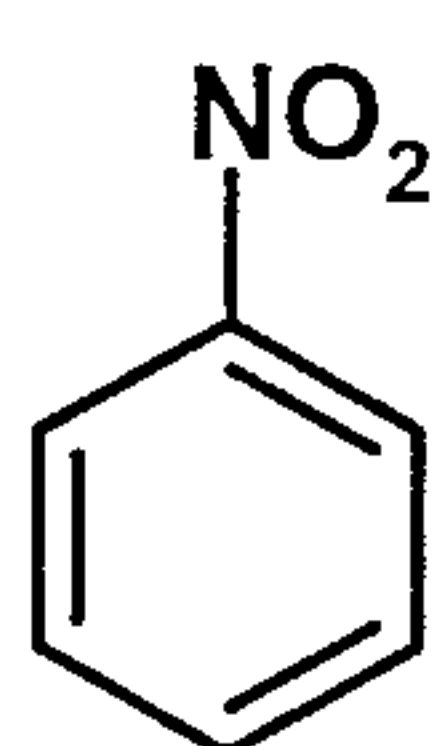
I. 排序題

(16%, 4% each)

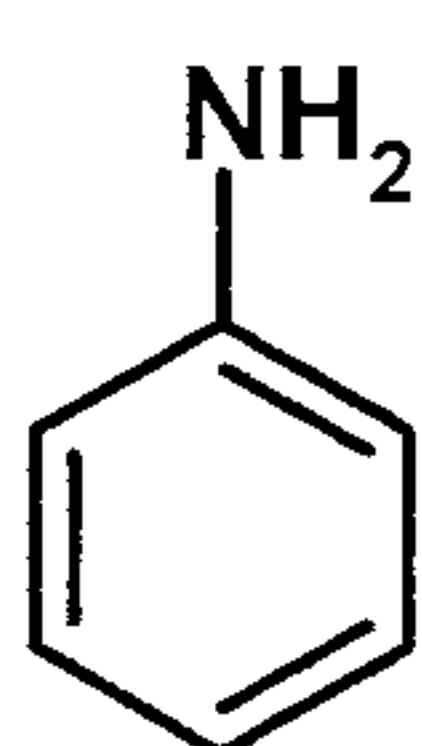
1. Please rank the following compounds in order of reactivity in electrophilic aromatic substitution.



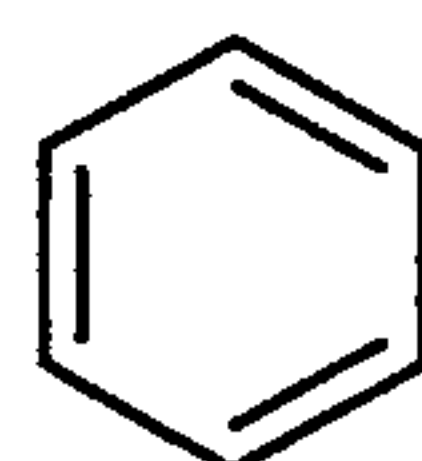
A



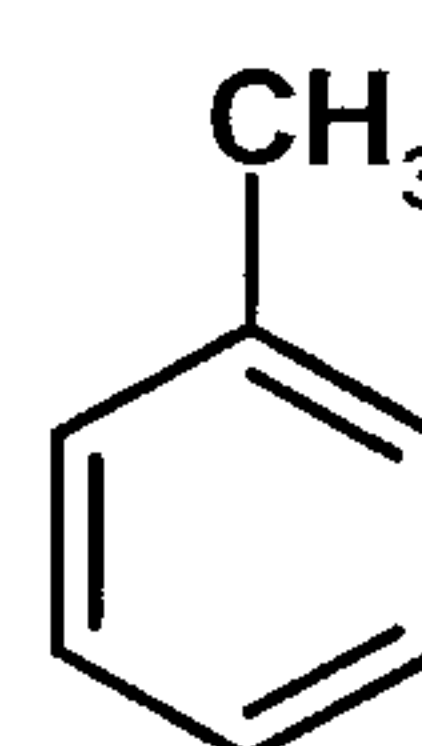
B



C

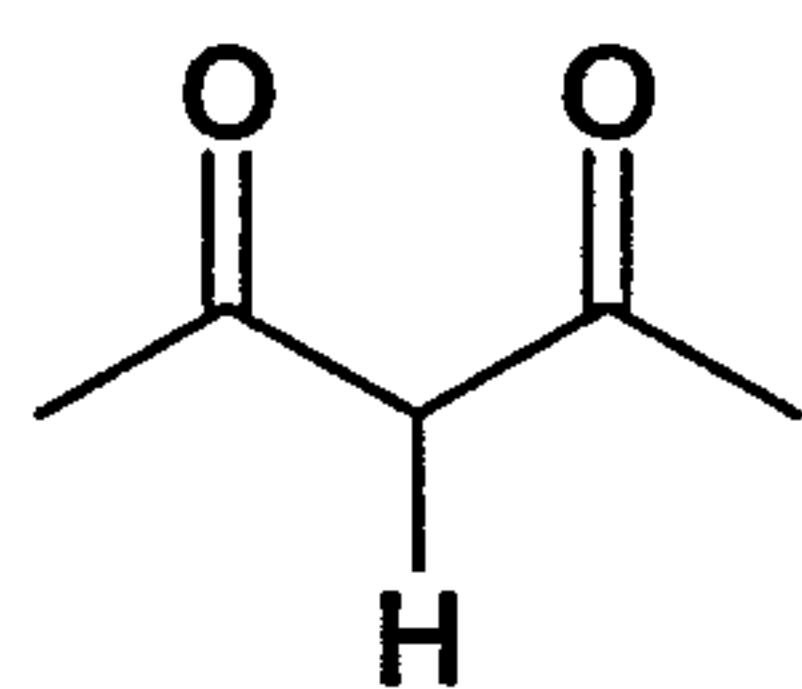


D

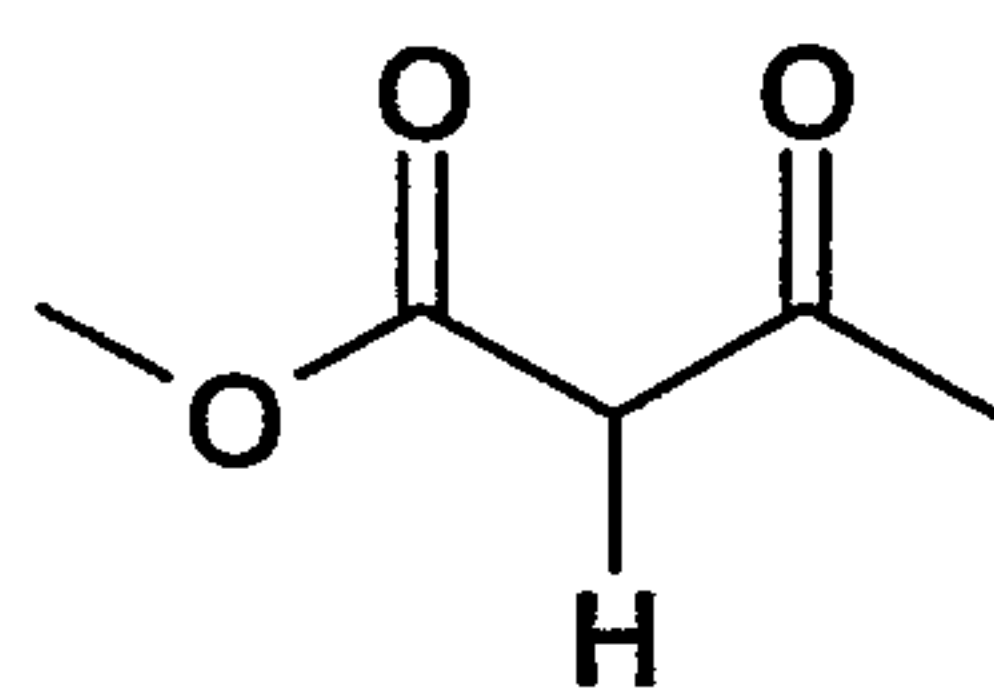


E

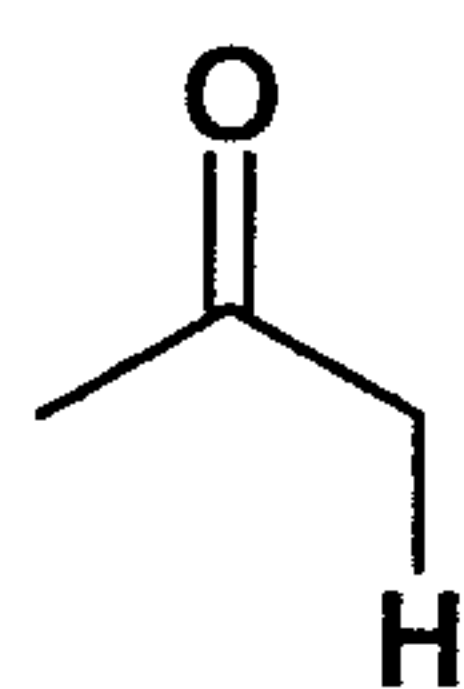
2. Please rank the following carbonyl compounds based on the acidity of the α -proton.



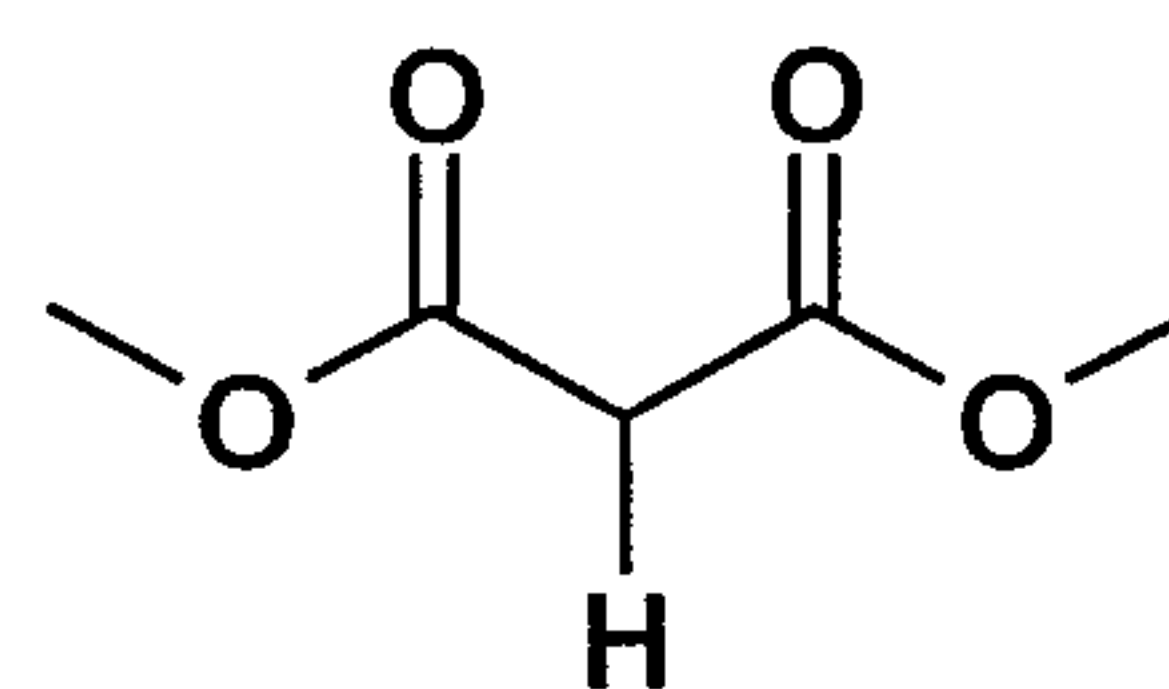
A



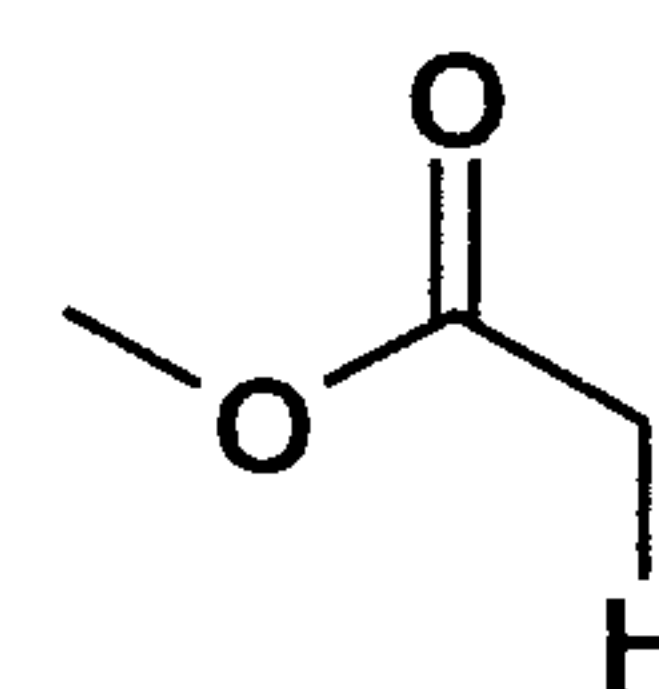
B



C

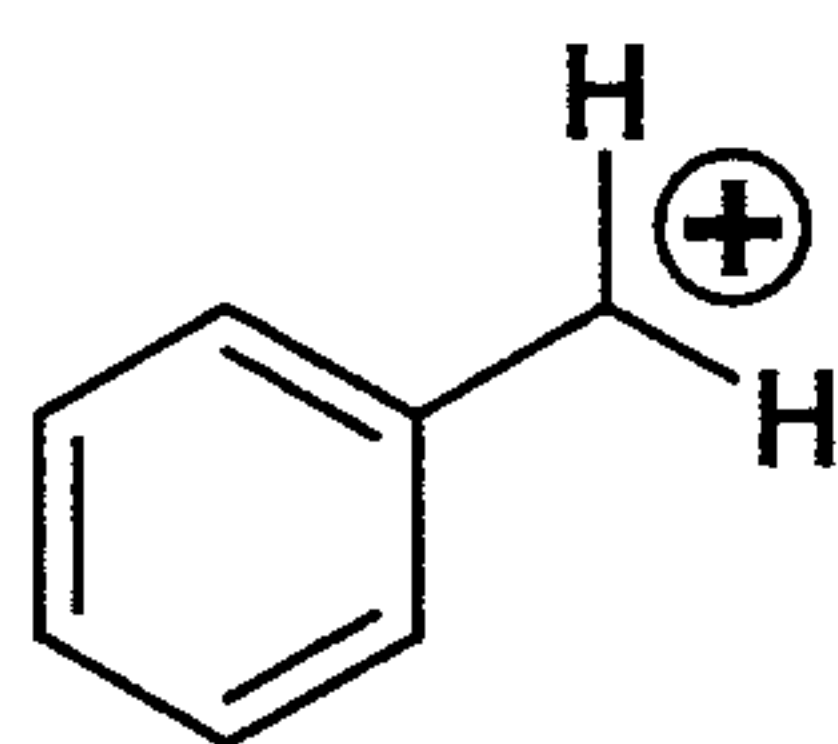


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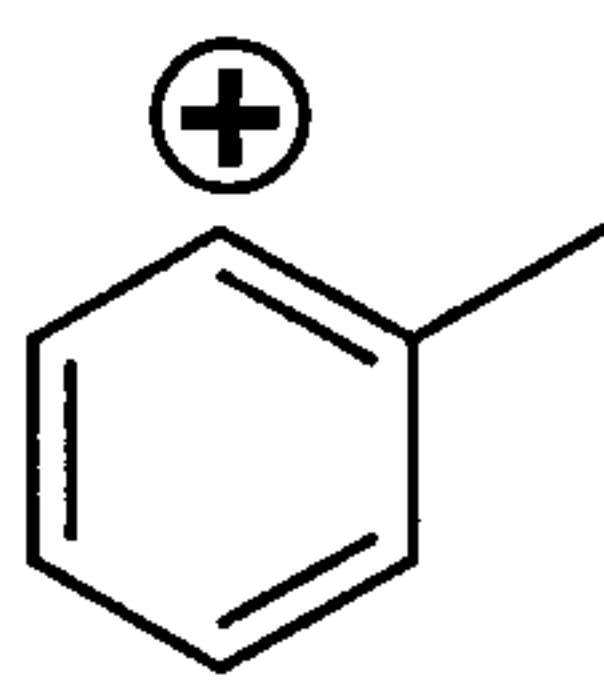


E

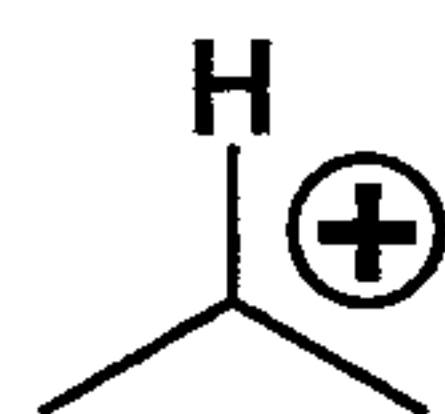
3. Please rank the following carbocations based on the stability.



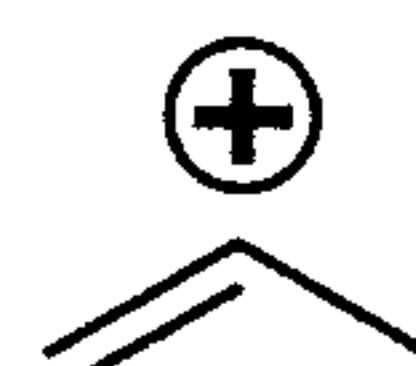
A



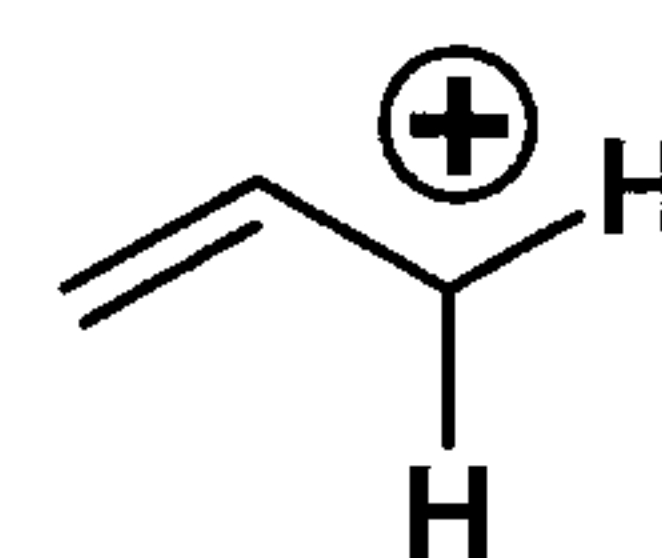
B



C



D



E

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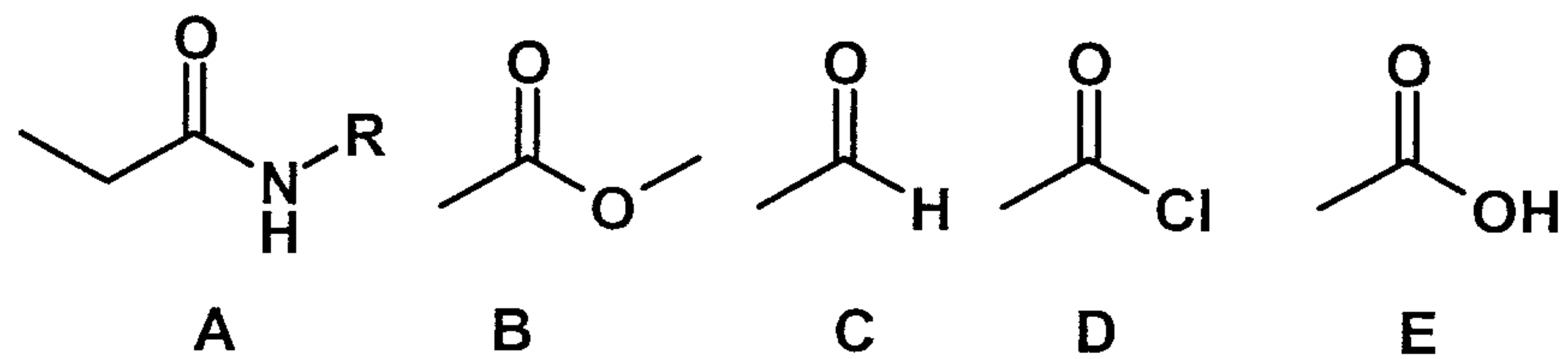
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4. Please rank the following carbonyl group peaks in IR spectra.



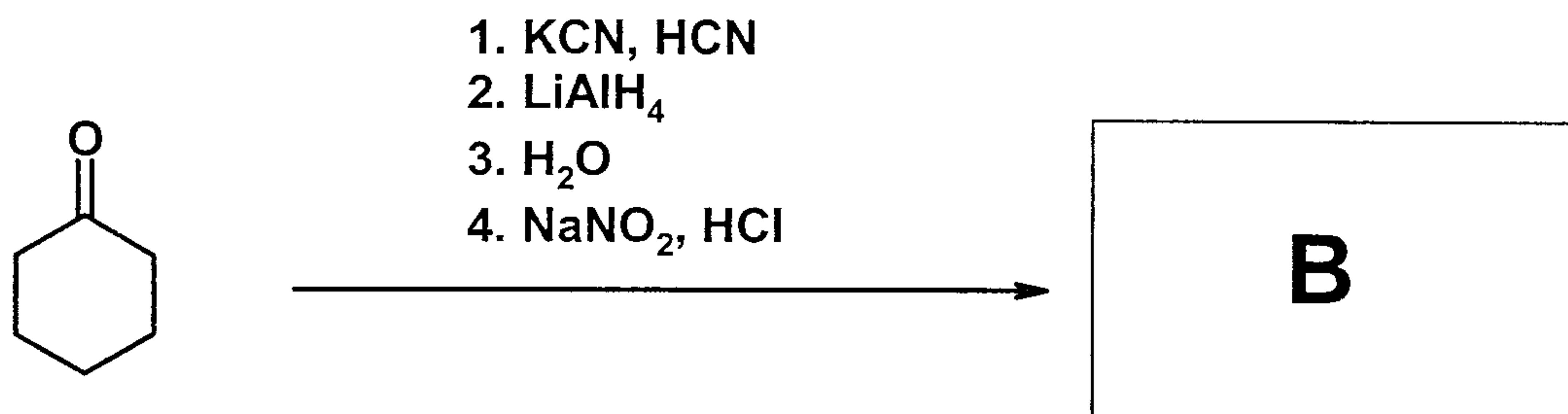
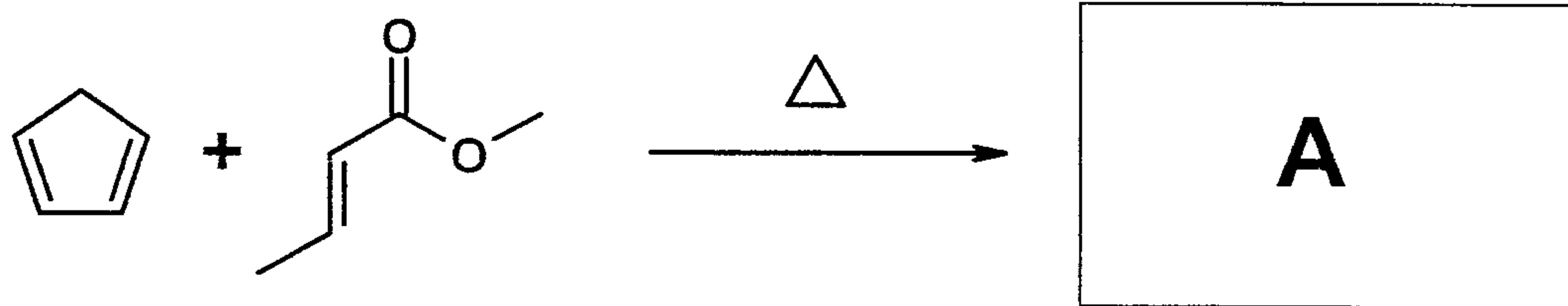
II. 填充題

(18%, 2% each)

1. Please label each stereocenter with * and indicate its *R* or *S* configuration.



2. Please predict the product of the following reactions.



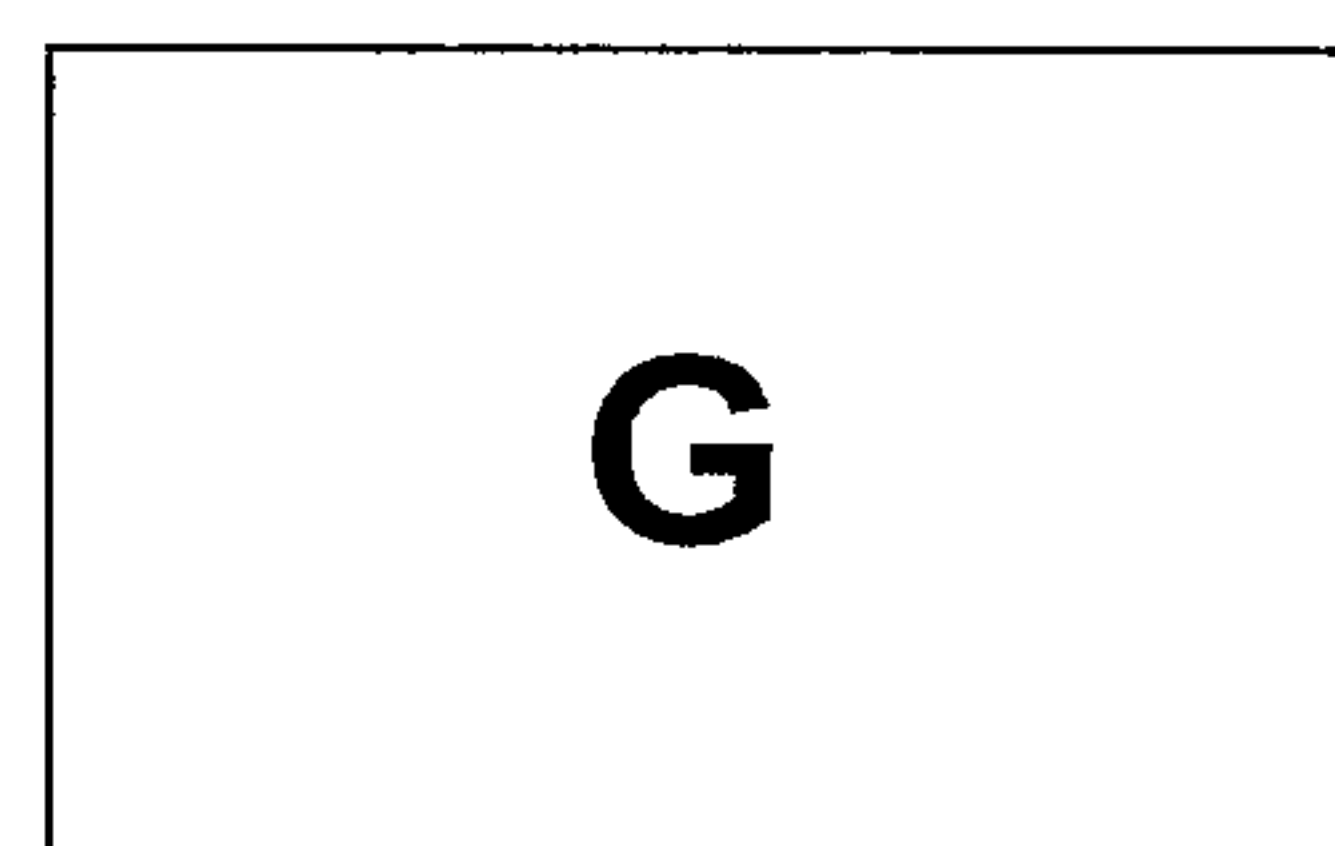
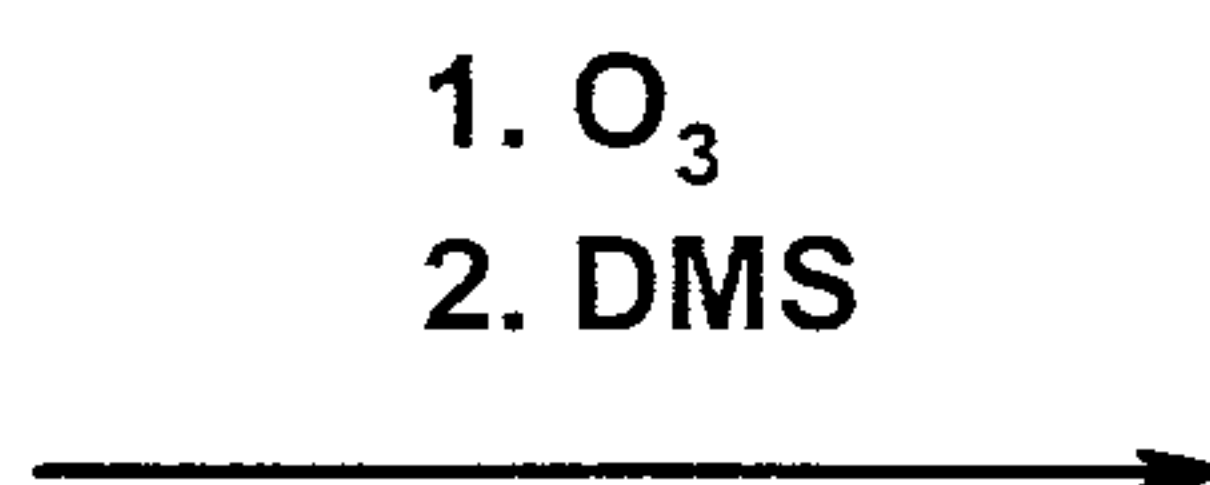
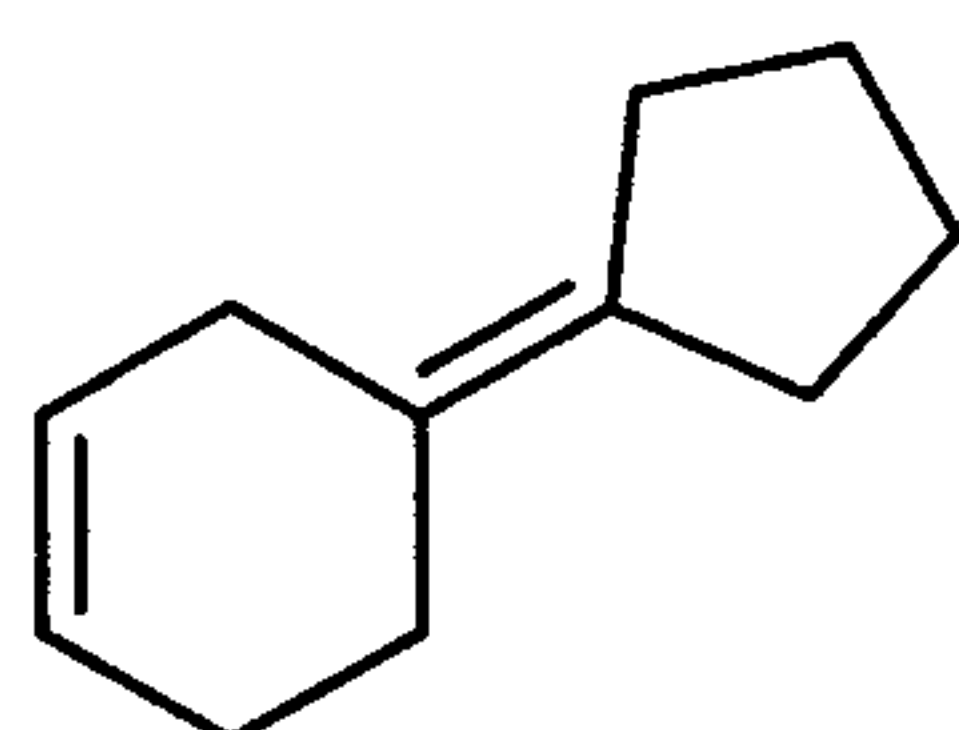
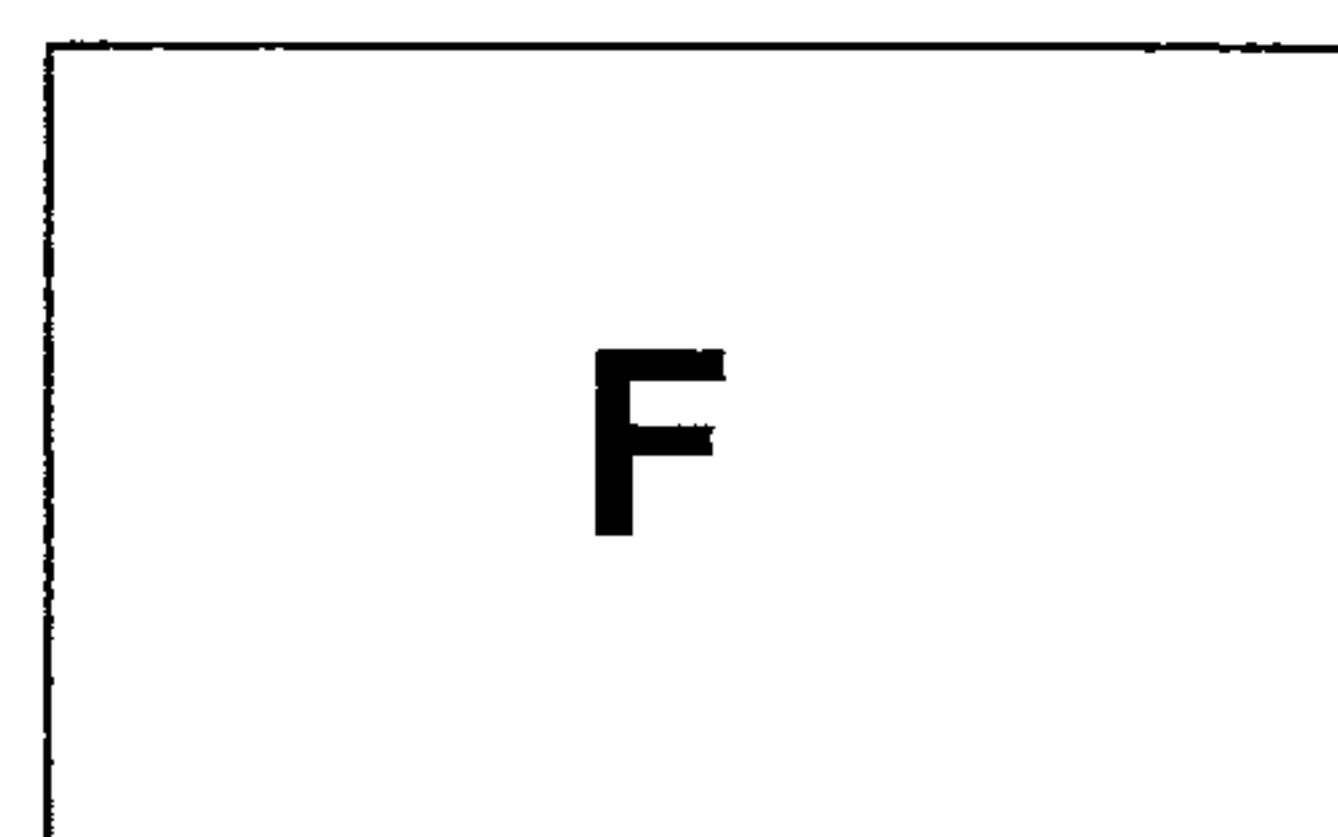
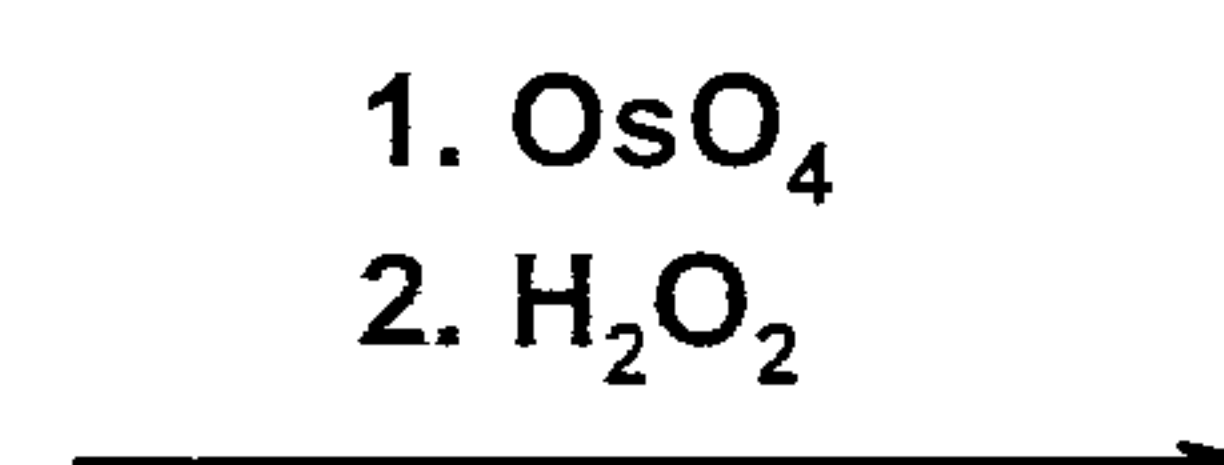
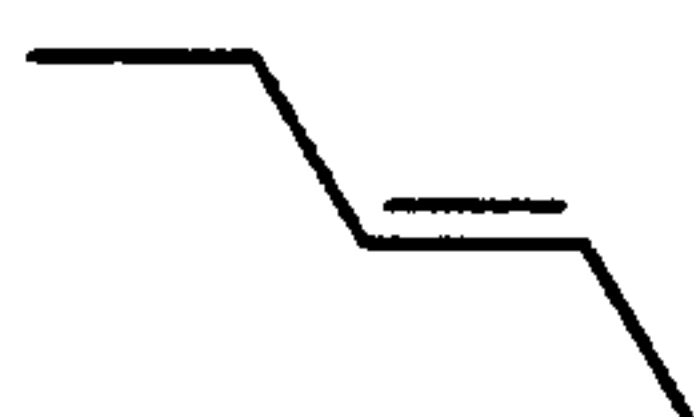
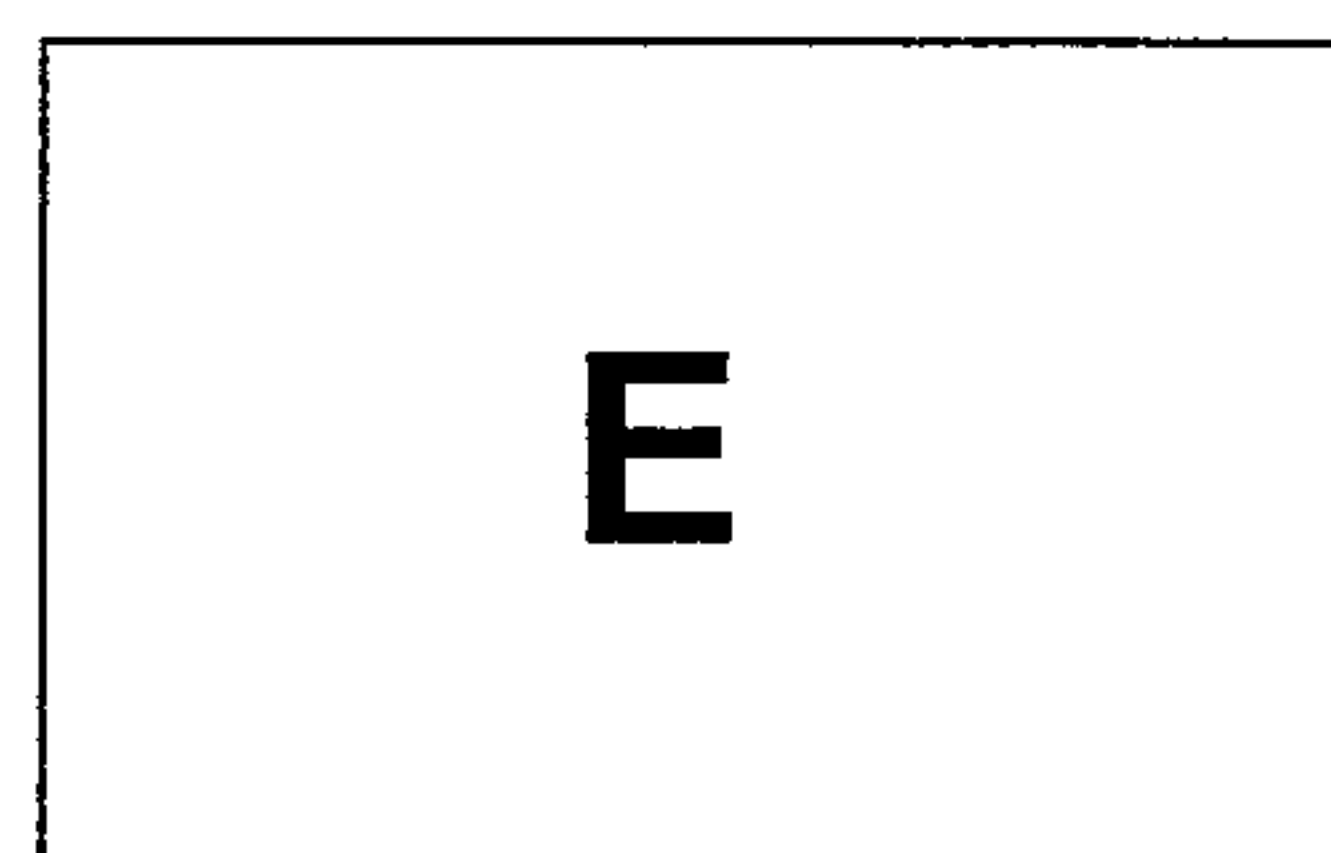
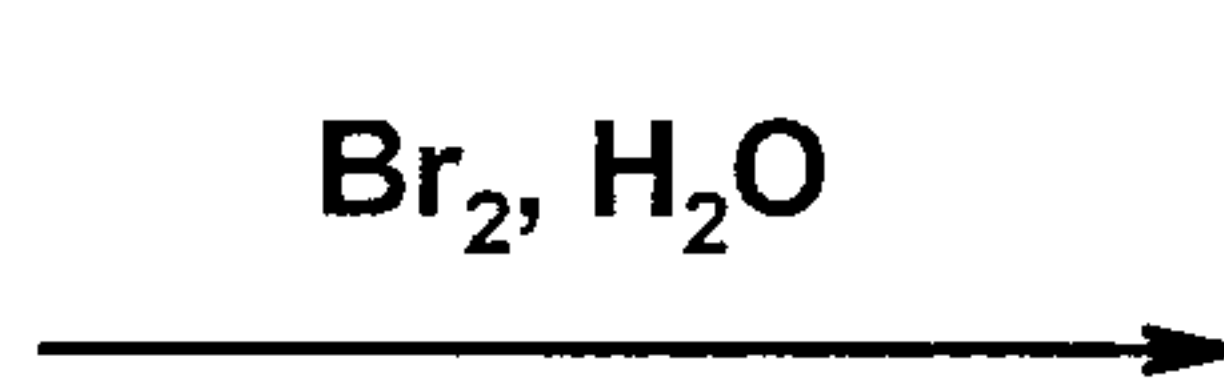
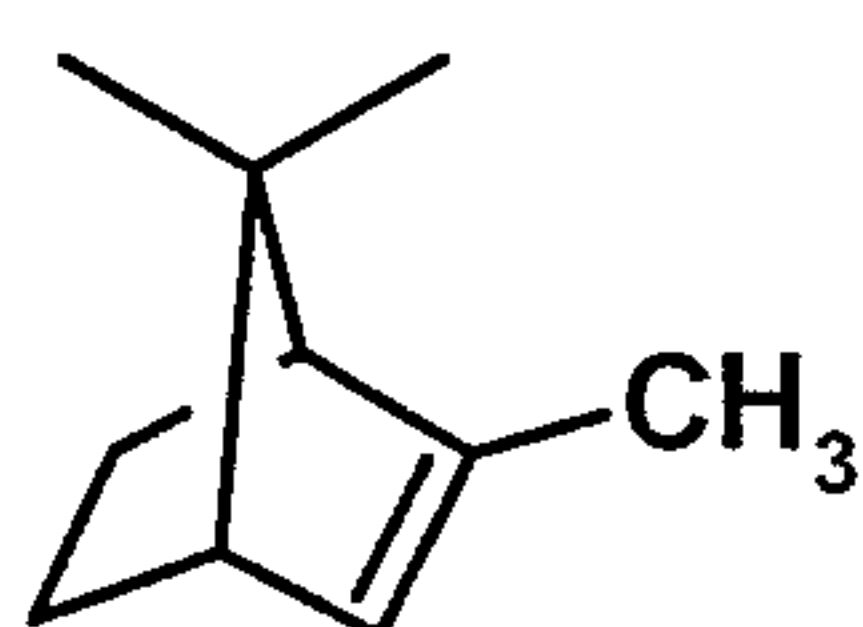
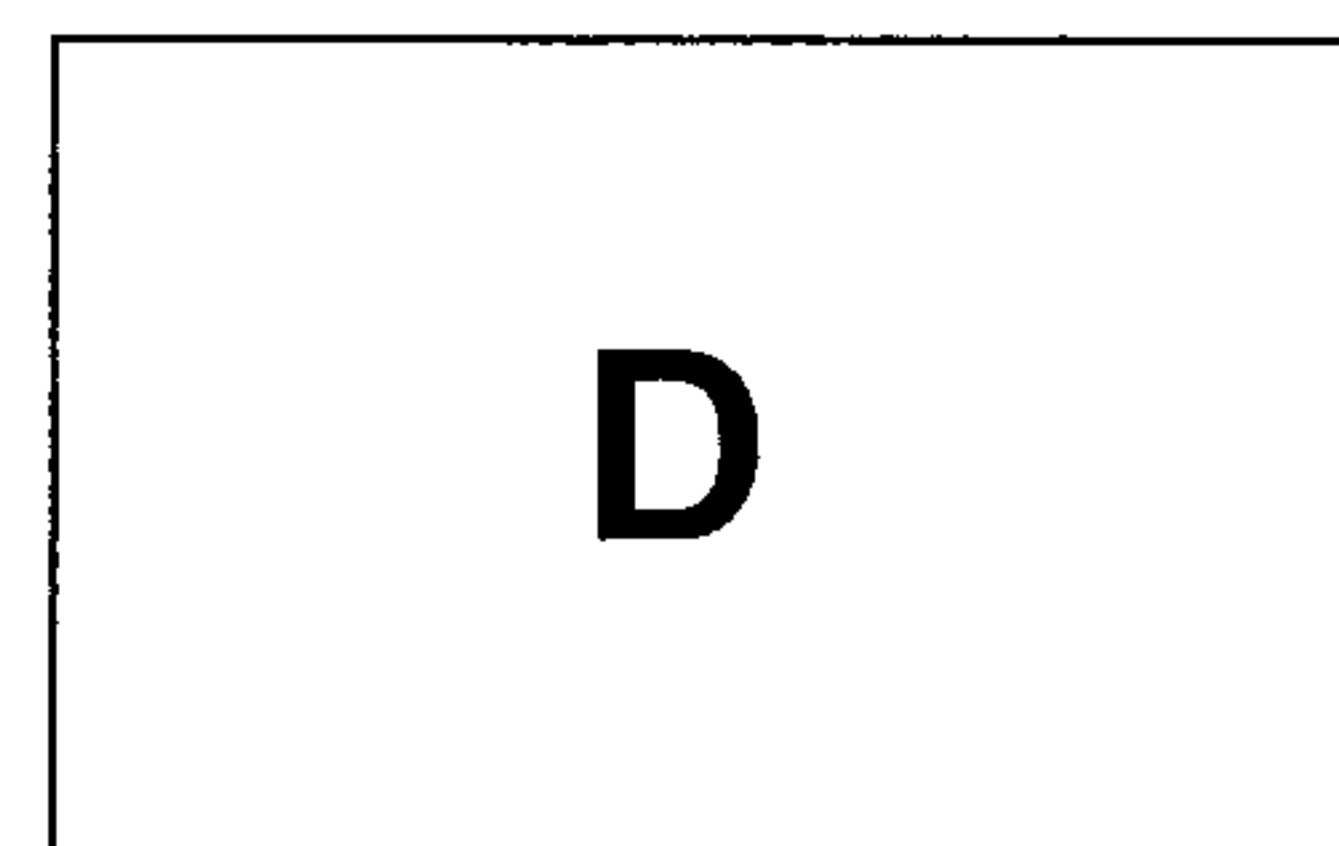
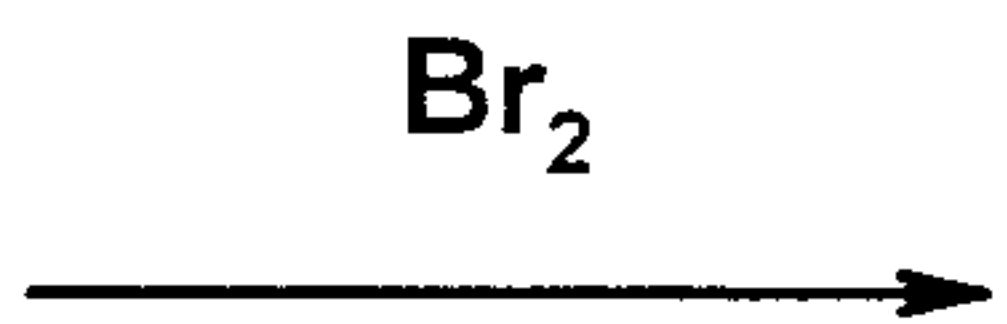
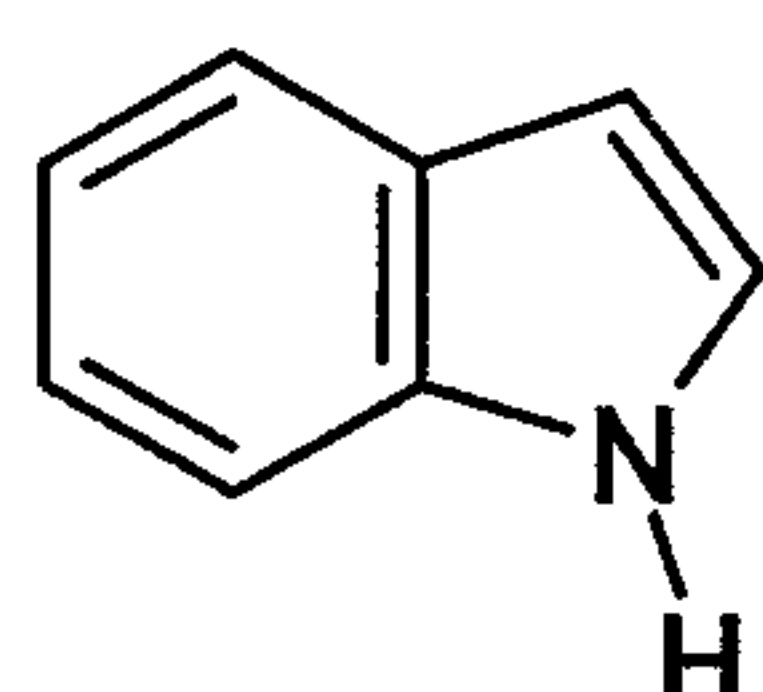
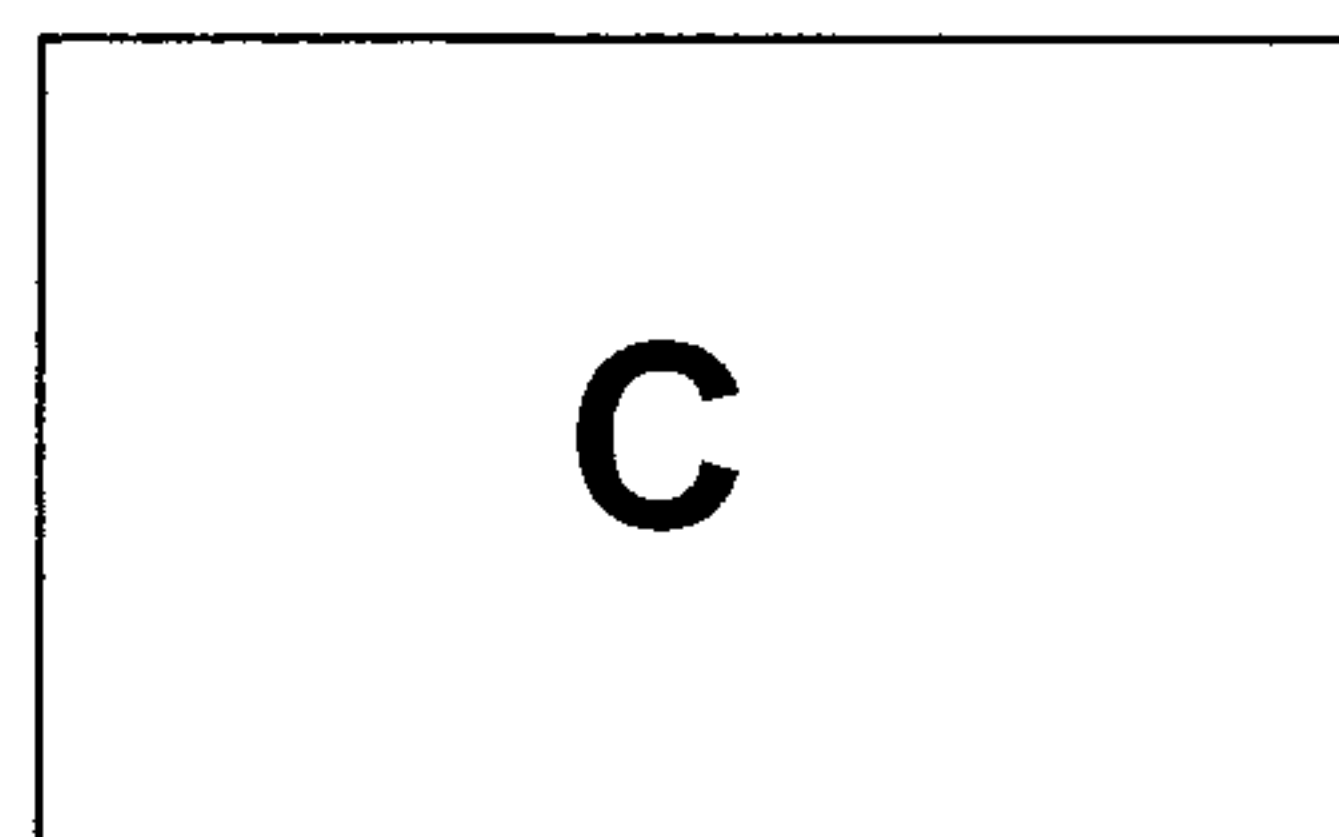
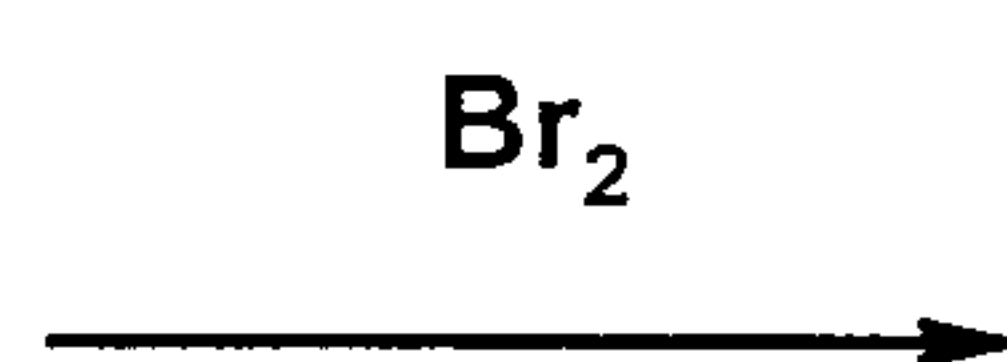
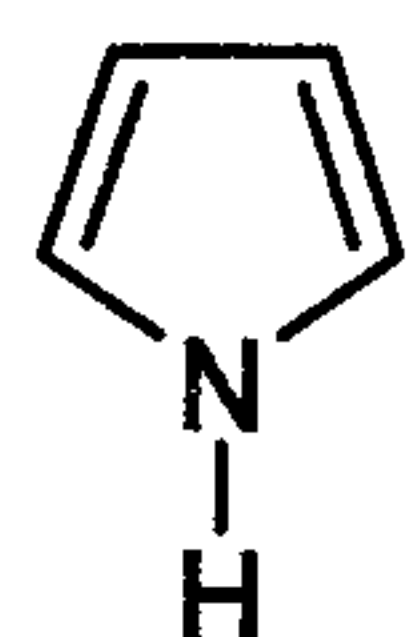
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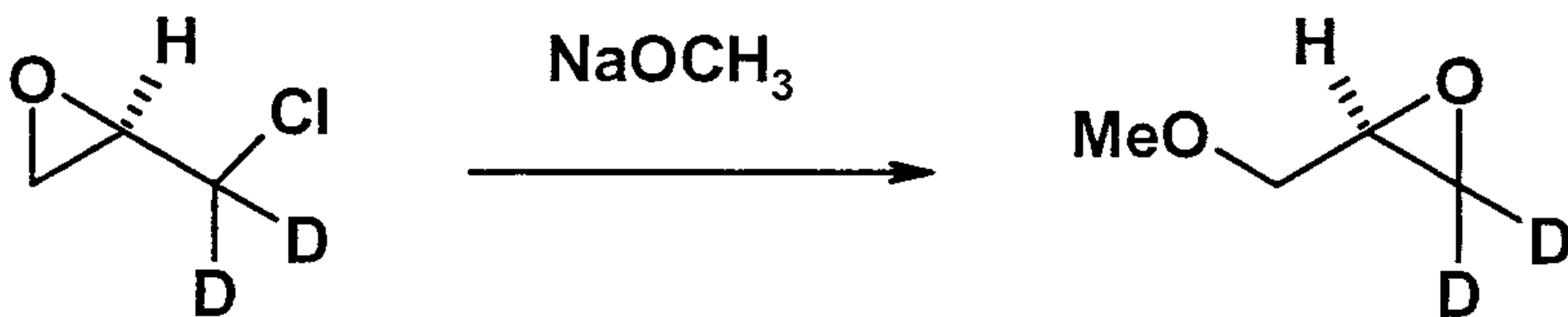
*請在【答案卷】作答

III. 問答題

(32%)

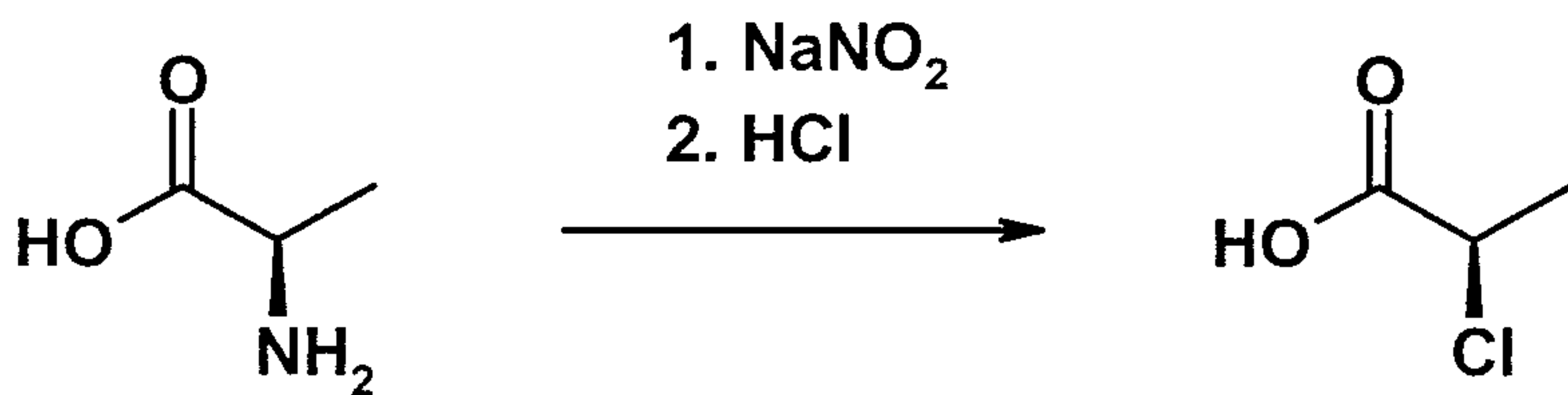
1. Please provide a mechanism of the following reaction.

(4%)



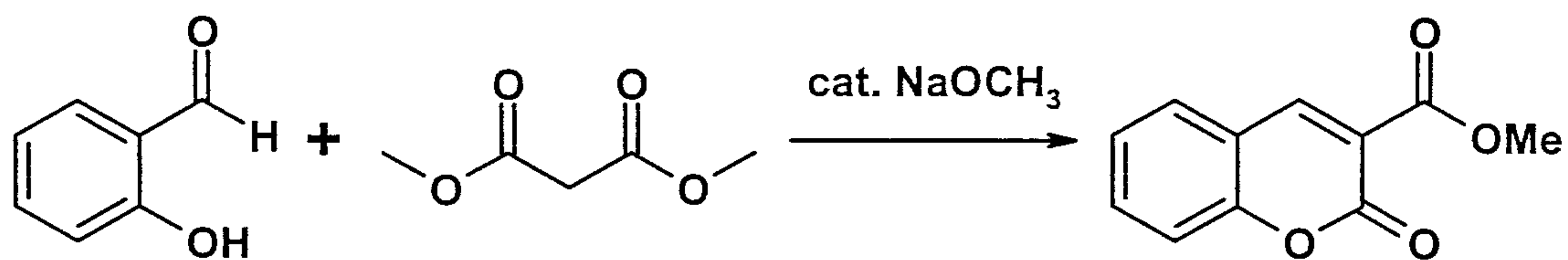
2. Please provide a mechanism of the following reaction.

(4%)



3. Please provide a detail mechanism for the following transformation. Please show the electron transfer by arrow.

(4%)



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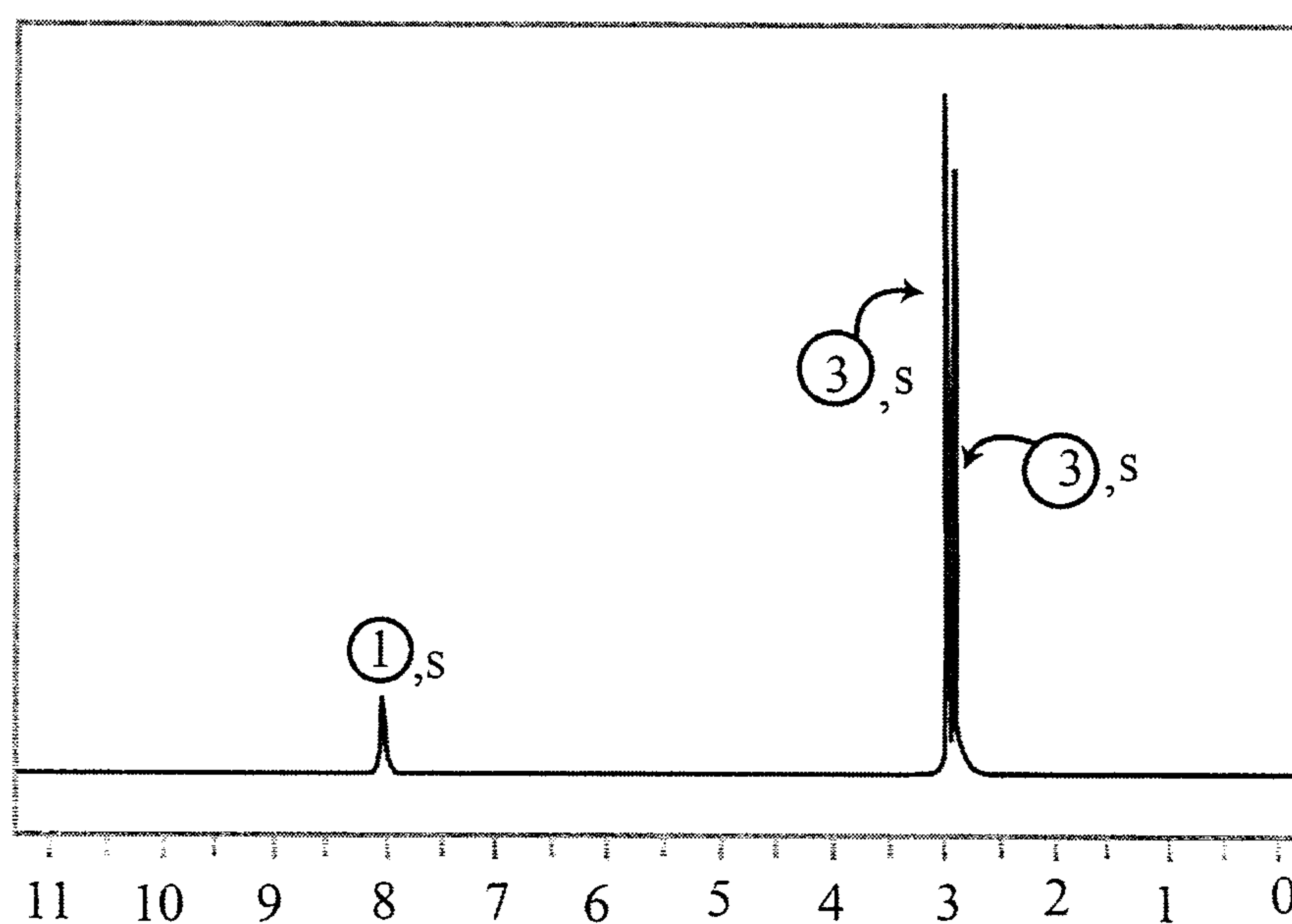
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*請在【答案卷】作答

4. Please solve the structure according the following information and the NMR spectra. (4%)



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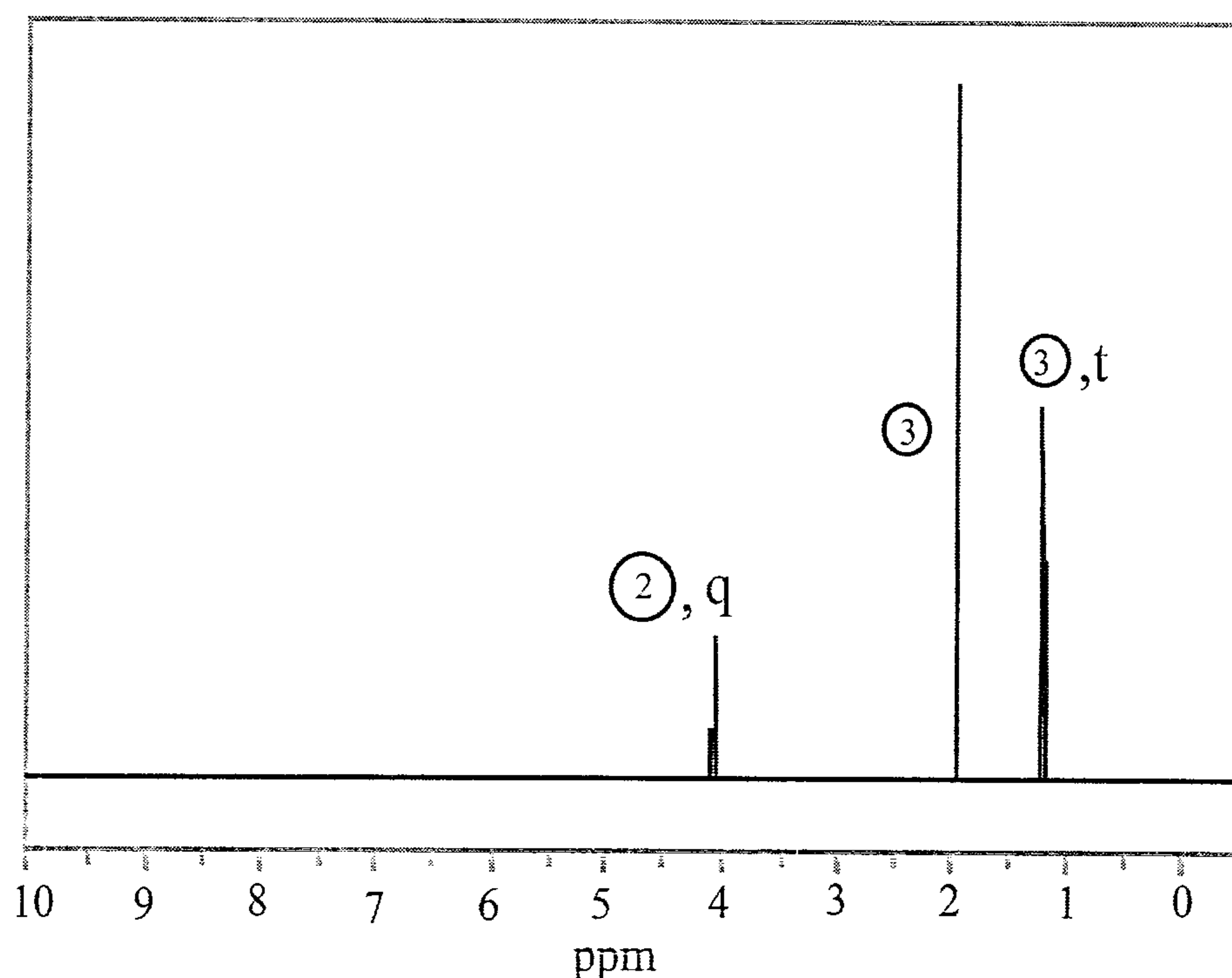
系所班組別：生命科學院乙組、醫學生物科技學程

考試科目（代碼）：有機化學(0502、0706)

共 10 頁，第 6 頁

*請在【答案卷】作答

5. Please solve the structure according the following information and the NMR spectra. (4%)



6. Please answer the questions and identify the structure according to the following information: (6%, 2% each)

EA C: 75.69 ; H: 8.80 M+ 206 IR 3430 (broad), 1705 (strong)

^{13}C NMR 181.4, 140.9, 137.0, 129.5, 127.4, 45.9, 44.1, 30.3, 22.5, 18.2

1H NMR 11.9 (broad, s, 1H), 2.44 (d, J=6.8, 2H), 1.84 (nonet (9 lines), J=6.8, 1H), 1.49 (d, J=7.0, 3H), 0.89 (d, J=6.8, 6H)

- Determine the molecular formula.
- Calculate the Index of Hydrogen Deficiency.
- Draw all possible enantiomers and diastereomers of the compound.

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*請在【答案卷】作答

7. Please answer the questions and identify the structure according to the following information: (6%, 2% each)

EA C: 81.61 ; H: 11.06; N: 7.32

MS 191, 176

^{13}C NMR 162.7, 136.5, 118.9, 35.1, 31.9

^1H NMR 7.59 (t, $J=7.8$, 1H), 7.14 (d, $J=7.8$, 2H), 1.34 (s, 18H)

- A. Determine the molecular formula.
- B. Calculate the Index of Hydrogen Deficiency.
- C. Draw the structure of the compound.

IV. 單選題

(34%, 2% each)

- 1. In a hydrogen bond between a water molecule and another biomolecule:
 - A) A hydrogen ion on the water molecule forms an ionic bond with a hydride ion on the other molecule.
 - B) The partial charge on a hydrogen of the water interacts with the partial charge on a hydrogen of the other molecule.
 - C) Hydrogen bond typically forms between a hydrogen atom and either a nitrogen, sulfur, or oxygen atom.
 - D) A hydrogen on the water molecule forms a covalent bond to a hydrogen atom on the other molecule.
 - E) The hydrogen atom is located between an oxygen atom of the water and a carbon atom of the other molecule.


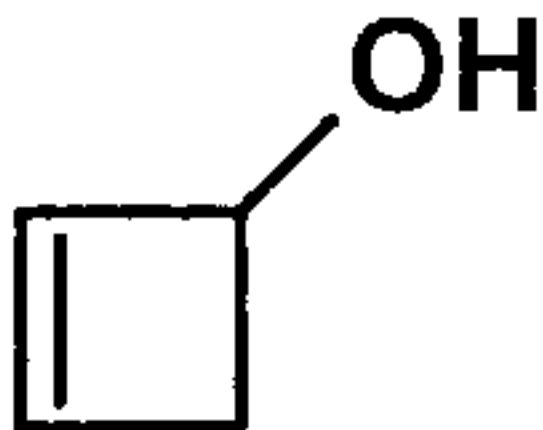
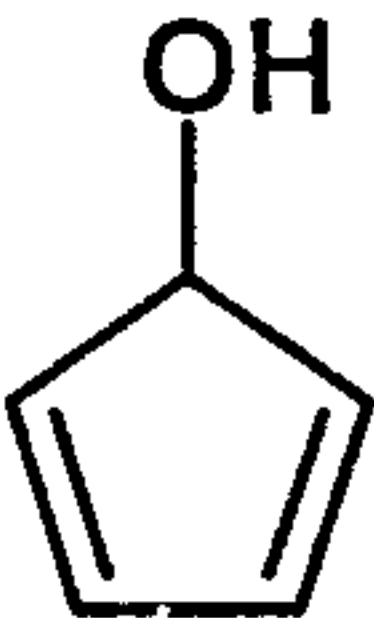
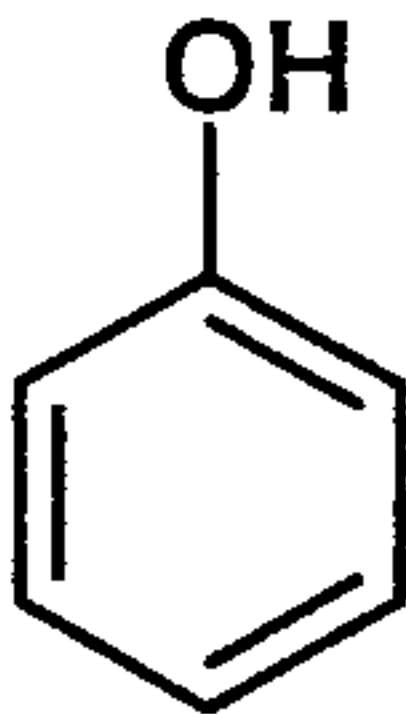
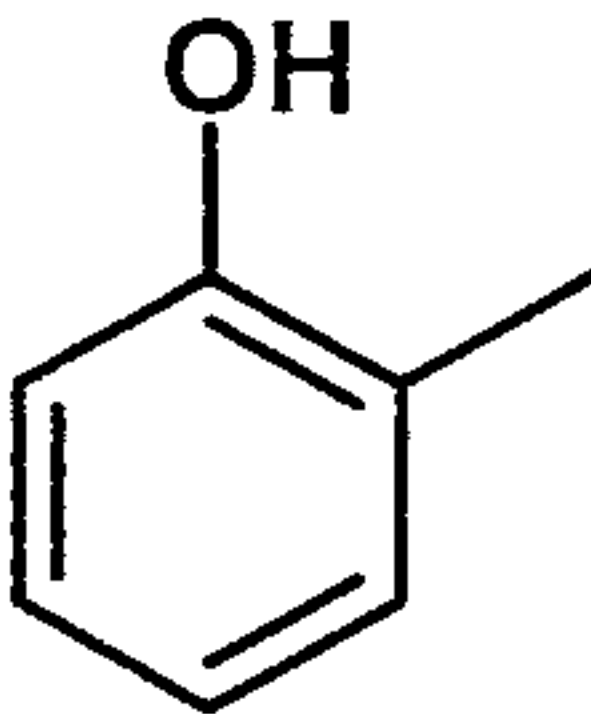
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*請在【答案卷】作答

2. Which of the following contributes to the blood buffering system:
- A) Reaction of CO_2 with H_2O to form carbonic acid
 - B) Ionization of aqueous carbonic acid to H^+ and the bicarbonate anion
 - C) Decrease of the blood pH due to the production of H^+
 - D) Excretion of bicarbonate and ammonium from the kidneys
 - E) All of the above
3. Which of the following is NOT a type of secondary structure found in proteins?
- A) β sheet
 - B) α helix
 - C) random coil
 - D) random turn
 - E) disulfide bond
4. Which of the following is the most likely to release water upon protonation with HCl?
- A)  B)  C)  D)  E) 
5. When carbon is placed at the center of a rectangle, how many isomers of formula CH_2YZ would be expected?
- A) 4
 - B) 6
 - C) 8
 - D) 10
 - E) 12

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6. Arrange the following compounds according to increasing order of boiling points.

I. 2,3-dimethylbutane

II. methane

III. neopentane

IV. n-hexane

V. n-undecane

A) I, II, III, IV, V

B) IV, II, I, III, V

C) III, V, IV, II, I

D) II, I, III, IV, V

E) V, IV, III, I, II

7. When cholesterol is dissolved in CHCl_3 at a concentration of 6.15 g/100 ml, and part of the solution is placed in a 5-cm polarimeter tube to give an observed rotation of -2.4° , calculate the number of specific rotation of cholesterol.

A) 0.0615

B) 1.21

C) -12

D) -39

E) -78

8. What color do you expect to observe if white light passes through a solution containing a dye that absorbs strongly the whole range of blue light ($4800 \pm 300 \text{ \AA}$)?

A) Blue

B) Green

C) Orange

D) Yellow

E) Purple-red

9. Hemoglobin is a protein responsible for carrying O_2 from human lungs to body tissues. It contains 0.355% iron, and hydrolysis of 100 g hemoglobin gives 1.48 g Tryptophan (M.W. 204). Calculate the minimum molecular weight of hemoglobin.

A) 35,500

B) 13,800

C) 15,800

D) 31,600

E) 63,200

10. Which of the following amino acids has the most basic nitrogen?

A) His

B) Trp

C) Pro

D) Lys

E) Arg

11. Which of the following polysaccharides does NOT contain glucose unit?

A) Cellulose

B) Amylose

C) Dextran

D) Amylopectin

E) None

12. Silicon is known to be more electropositive than carbon, and silylamines are expected to be more basic than corresponding organic amines. However, silylamines are much weaker bases. Which of the following plays a key role in such feature?

A) Silylamine has higher molecular weight than corresponding organic amine

B) Si-X bond has partial double bond character of $d_{\pi}-p_{\pi}$ type

C) Lone-pair electron density on nitrogen is higher in silylamine

D) Protonation of silylamine stabilizes resonance structure and resonance energy

E) More ionization takes place in silylamin

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13. When phenol samples are exposed to air for a while, what is the color generally observed because of oxidization?

- A) Blue B) Green C) Orange D) Pink E) Yellow

14. Which of the following test-tube reaction may distinguish between $\text{CH}_3\text{CH}_2\text{NHCl}$ and $\text{CH}_3\text{CH}_2\text{NH}_3\text{Cl}$?

- A) Nitrous acid (HONO) B) Aqueous base C) Aqueous acid
D) Aqueous hydrogen chloride E) Crown ether

15. An unknown aromatic compound X has a molecular formula of $\text{C}_7\text{H}_5\text{N}$. Upon catalytic hydrogenation it becomes $\text{C}_7\text{H}_{15}\text{N}$. Hydrolysis of X in the presence of NaOH yields C_6H_6 . What will be the end product upon further catalytic hydrogenation?

- A) $\text{C}_6\text{H}_5\text{CN}$ B) C_6H_6 C) C_6H_8 D) C_6H_{10} E) C_6H_{12}

16. How can methylcyclopropane be derived from $(\text{CH}_3)_2\text{CHCH}_2\text{N}_2^+$?

- A) Denitrogenation + 1,2 β -elimination B) Reduction + rearrangement
C) Denitrogenation + 1,3 γ -elimination D) Oxidation + elimination
E) Hofmann elimination

17. When a compound Y with a molecular formula of $\text{C}_5\text{H}_{11}\text{Br}$ reacts with H_2O , it rapidly becomes $\text{C}_5\text{H}_{12}\text{O}$. When Y reacts with sodium methoxide, it becomes an alkene C_5H_{10} , which further gives a ketone $\text{C}_3\text{H}_6\text{O}$ and an aldehyde $\text{C}_2\text{H}_4\text{O}$ upon ozonolysis. What is molecular structure of Y?

- A) $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$ B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$
C) $\text{CH}_3\text{CH}_2\text{C}(\text{Br})(\text{CH}_3)_2$ D) $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{CH}_2\text{CH}_3$
E) $(\text{CH}_3)_3\text{CCH}_2\text{Br}$