

國立清華大學 104 學年度碩士班考試入學試題

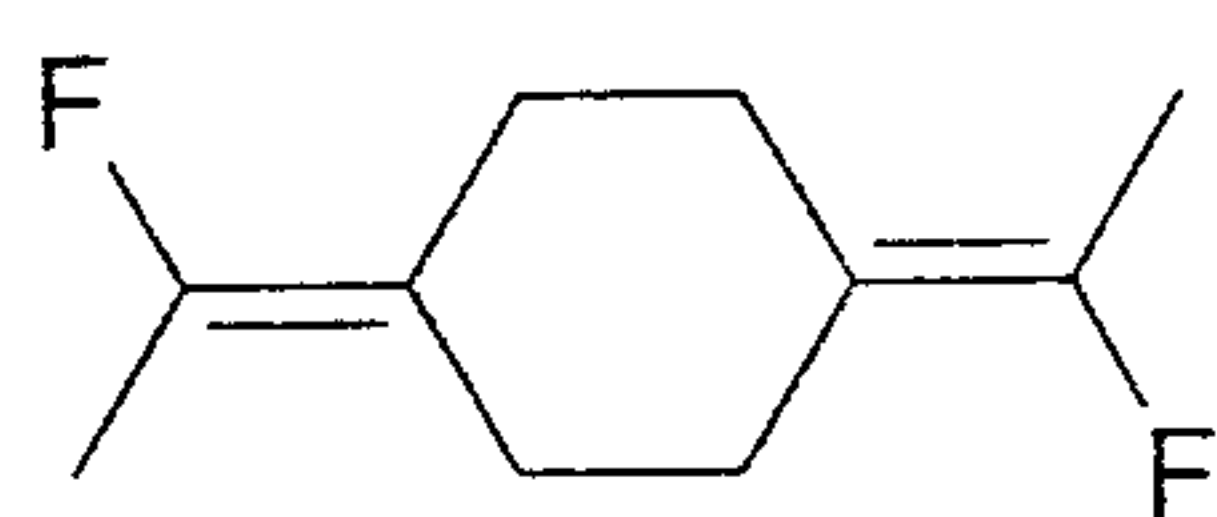
系所班組別：生命科學院乙組、醫學生物科技學程

考試科目（代碼）：有機化學(0502、0706)

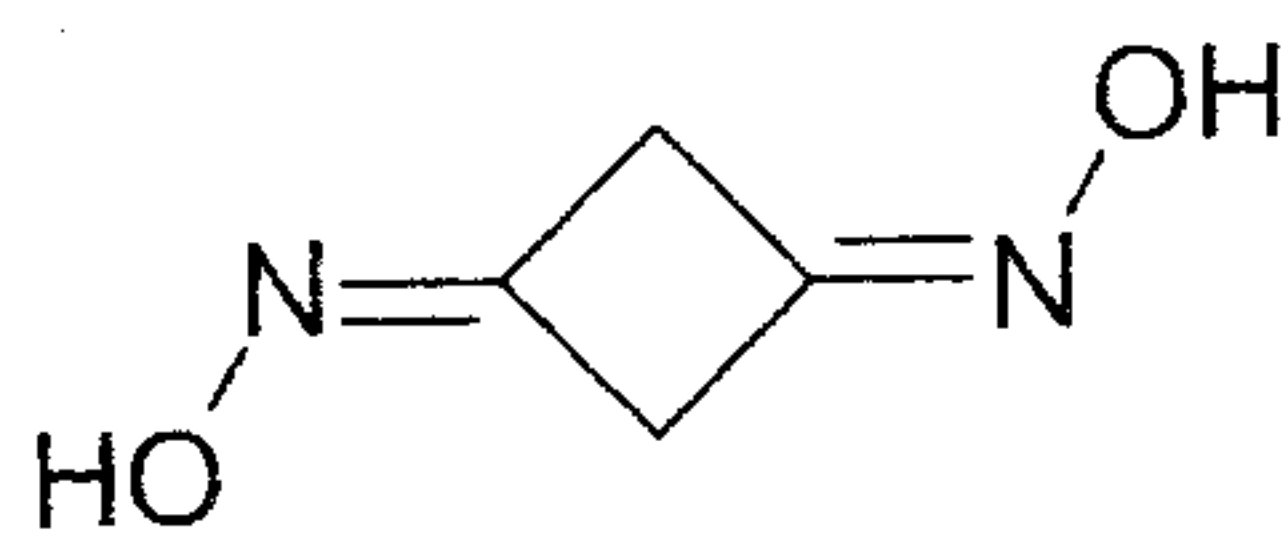
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*請在【答案卷】作答

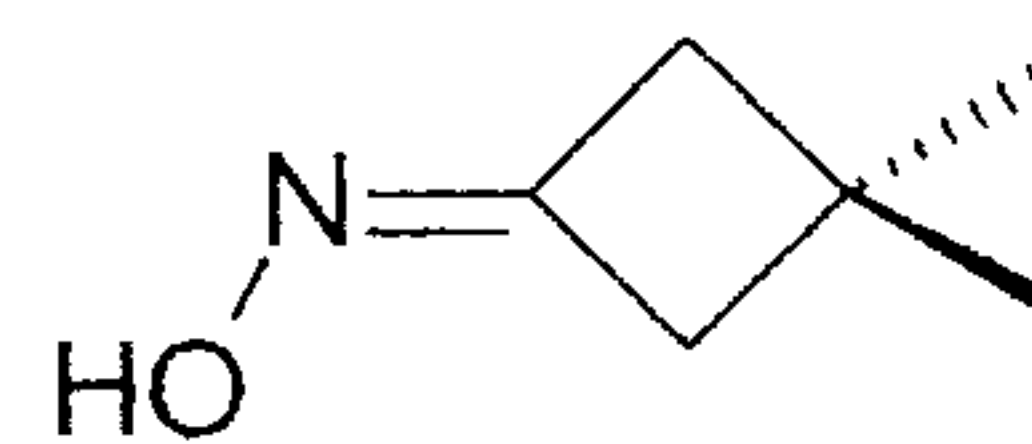
1. Which of the following compounds is chiral? (3%)



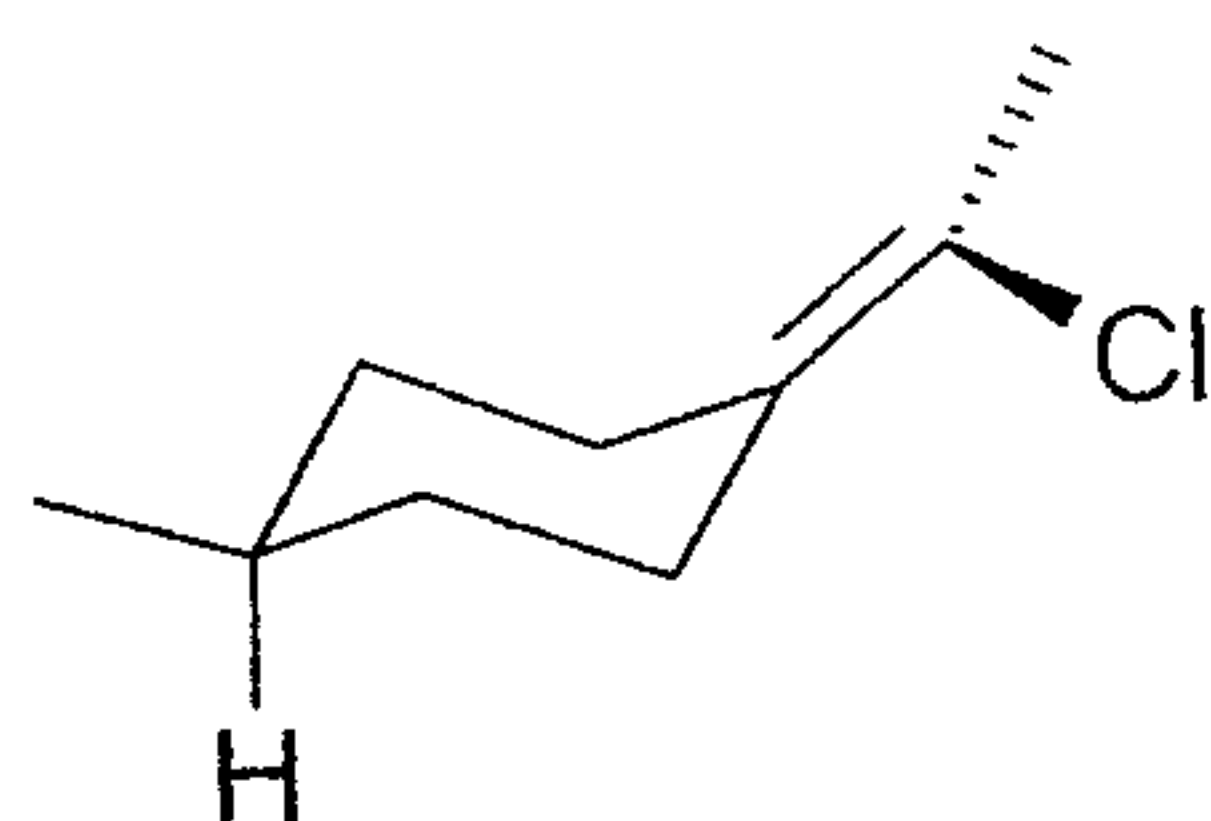
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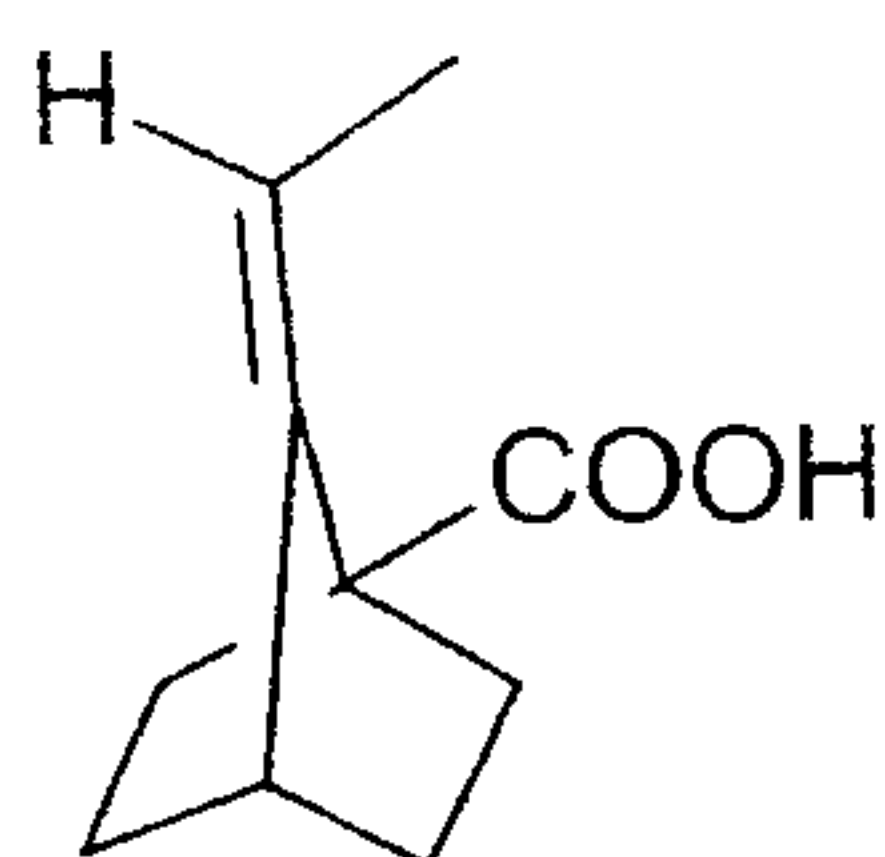
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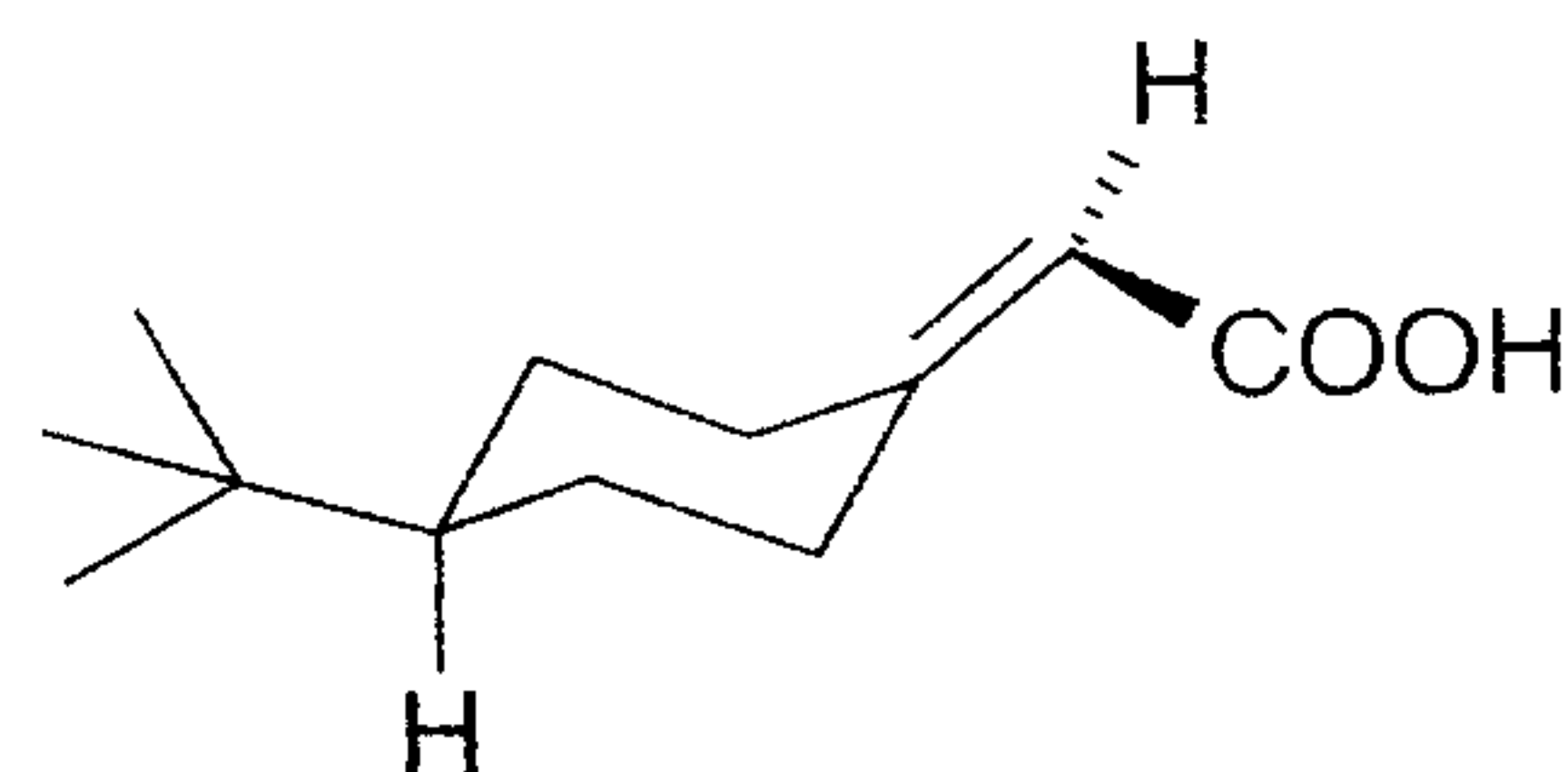
C



D



E



F

2. Draw all stereoisomers of each of the following molecules: (a) 1,3-dichlorocyclopentane; (b) 2,3-difluoropentane. (6%)

3. Draw structure and identify the stereogenic carbon atom with a *. (6%)

(a) 3-chloro-4,5-dimethylnonane;

(b) 3,3-diethylpentane;

(c) 3-methyl-5,6-diphenyl-1-hexanol.

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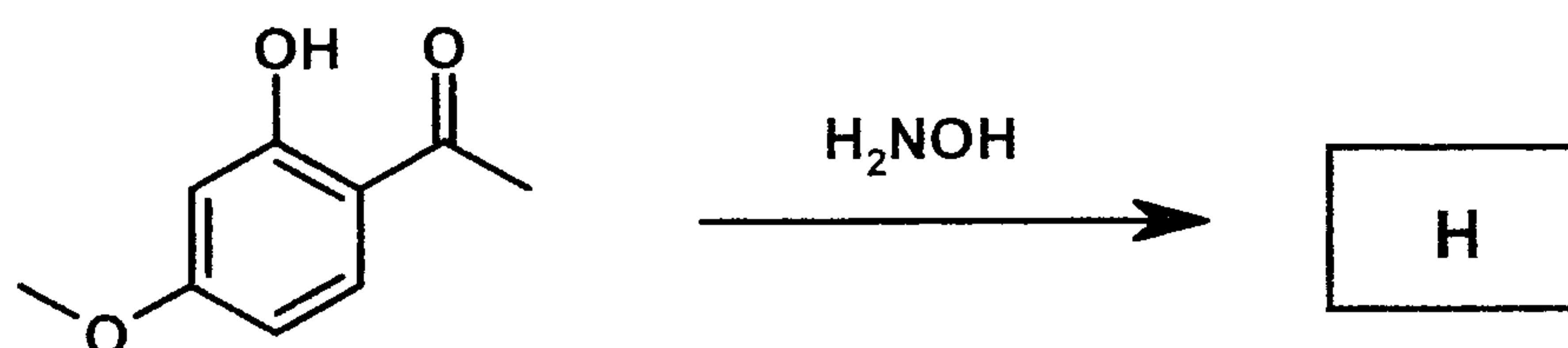
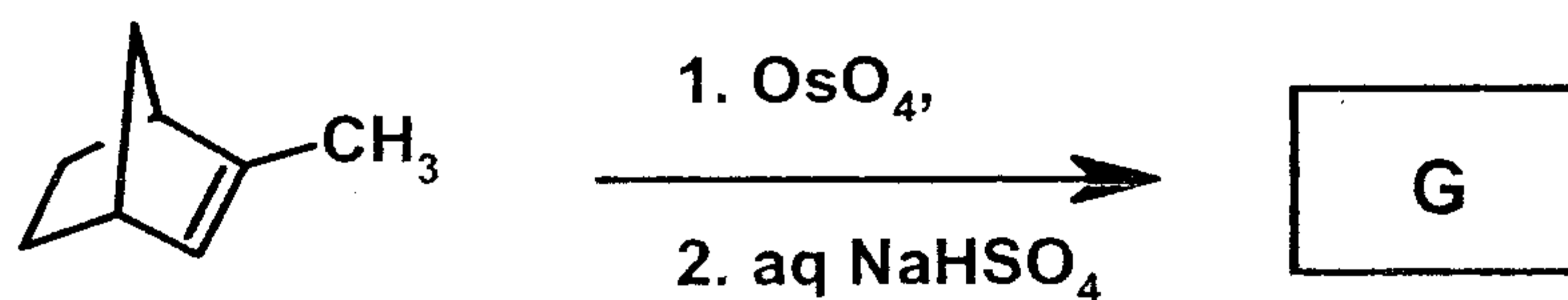
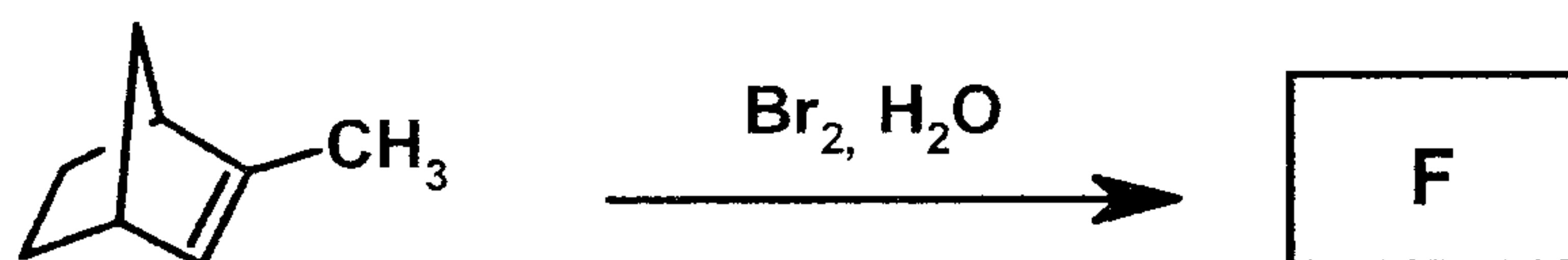
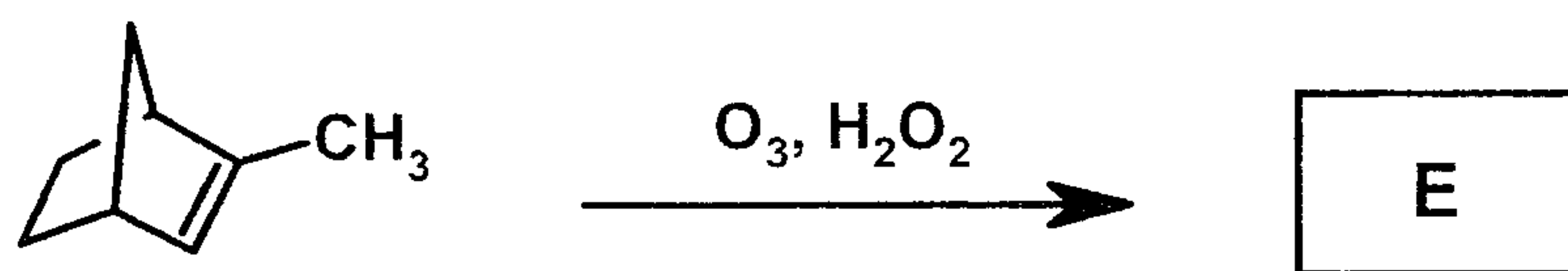
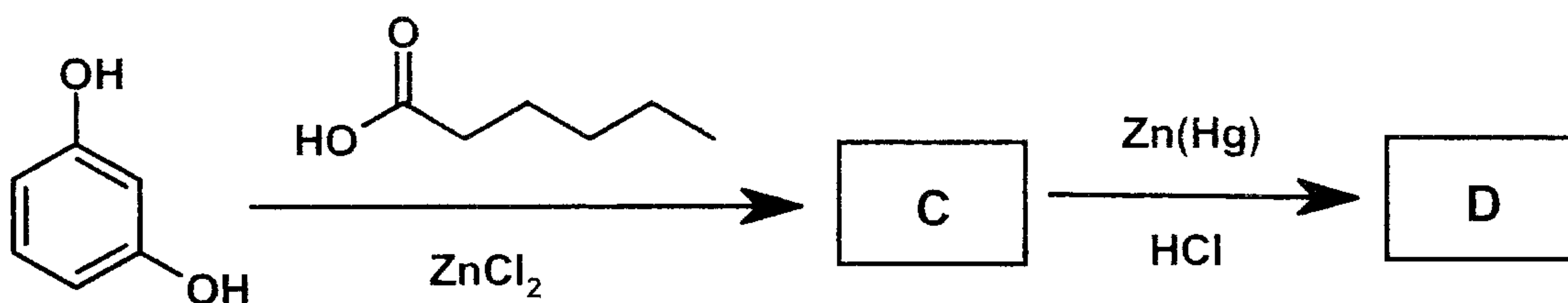
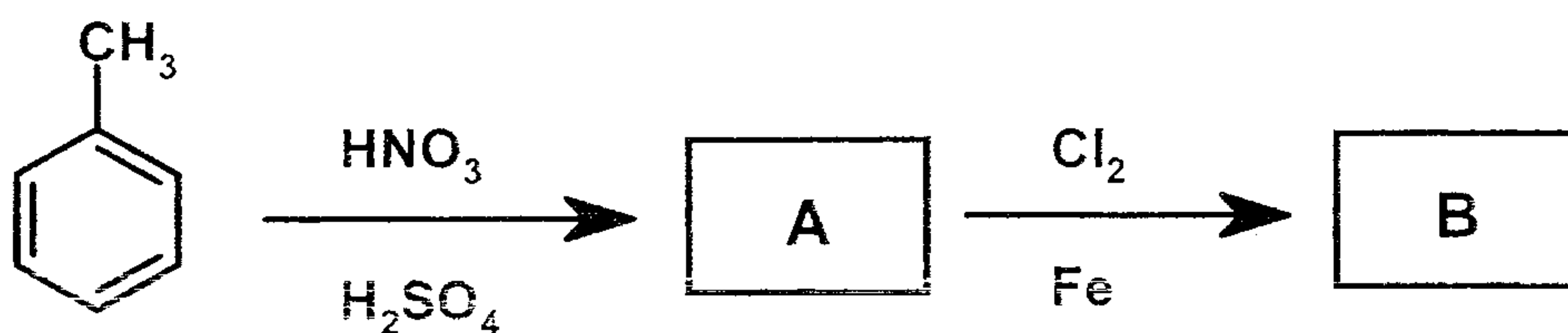
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4. Please predict the product of the following reaction. (3 point each)



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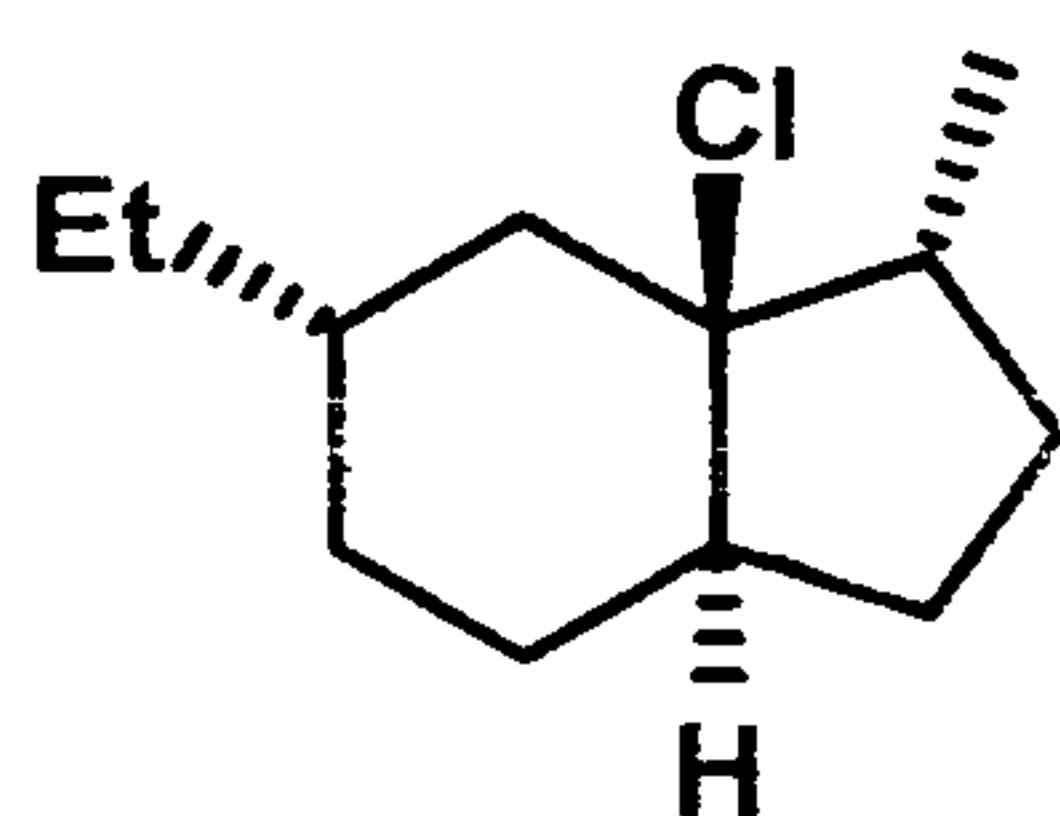
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共 10 頁，第 3 頁

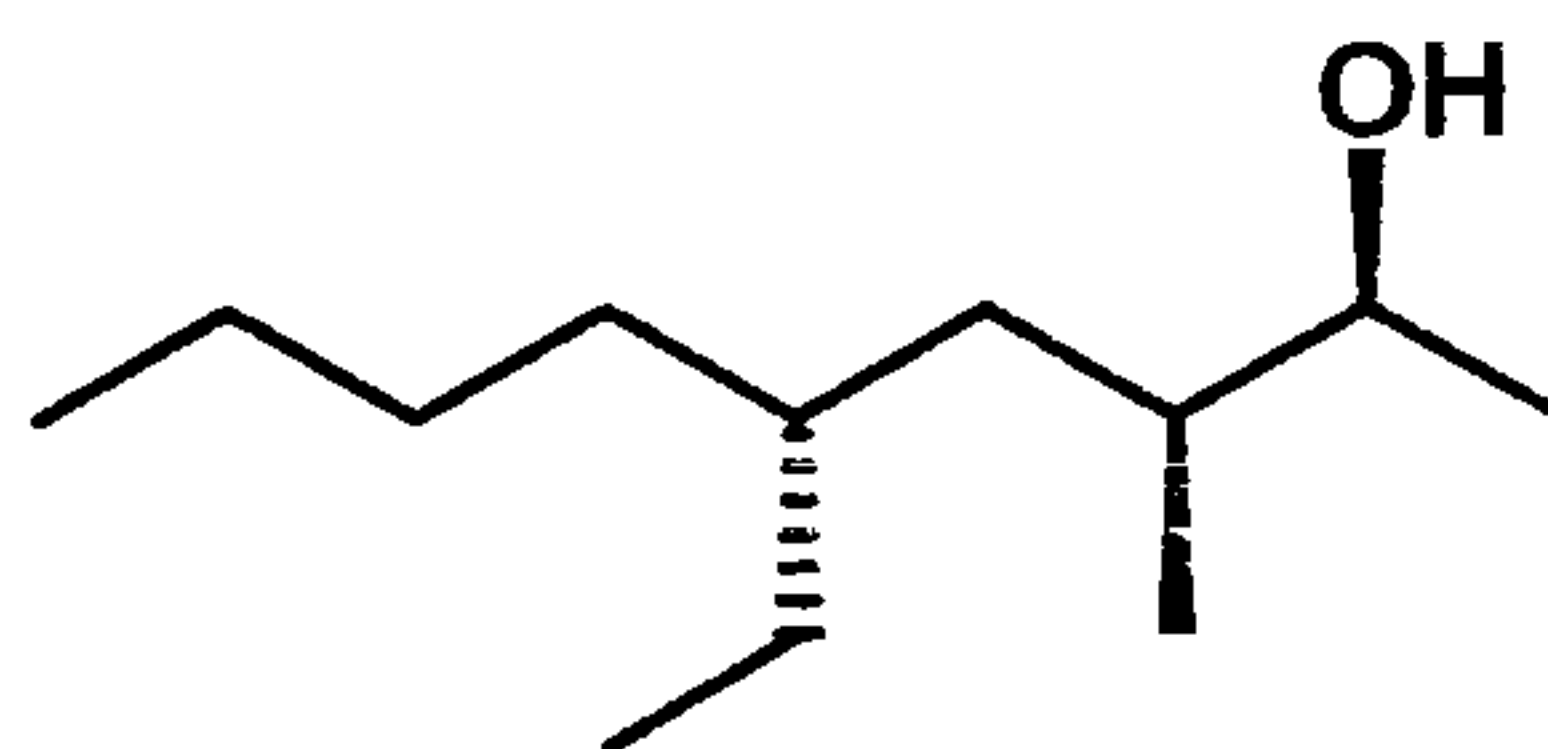
*請在【答案卷】作答

5. Please label each stereocenter with * and its *R* or *S* configuration. (6%)

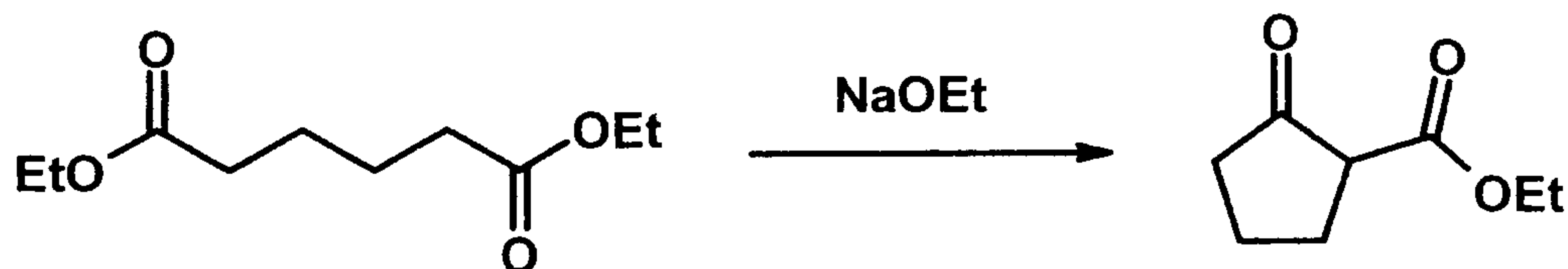
(a)



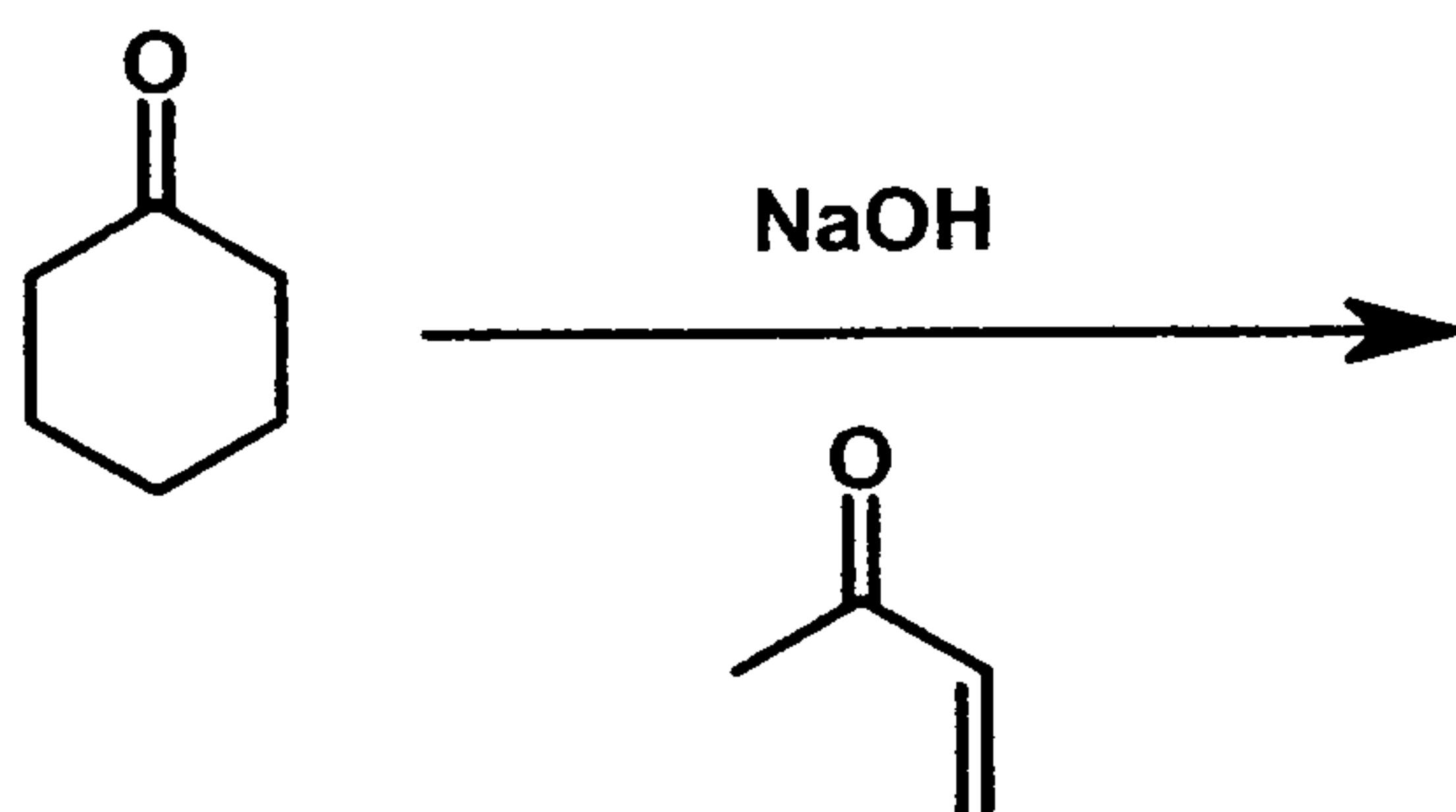
(b)



6. Please provide the mechanism of the following reaction. (5%)



7. Please provide the product and mechanism of the following reaction. (5%)



8. Please identify **C₁₀H₈O₂** structure according the following information: (5%)

IR 2106 cm⁻¹, 1733 cm⁻¹, 1275 cm⁻¹;

¹H NMR d 3.23 (1H, s), 3.92 (3H, s), 7.55 (2H, d, JZ8.5 Hz), 7.98 (2H, d, JZ8.5 Hz);

¹³C NMR d 52.25, 80.00, 82.77, 126.73, 129.43, 130.11, 132.05, 166.39;

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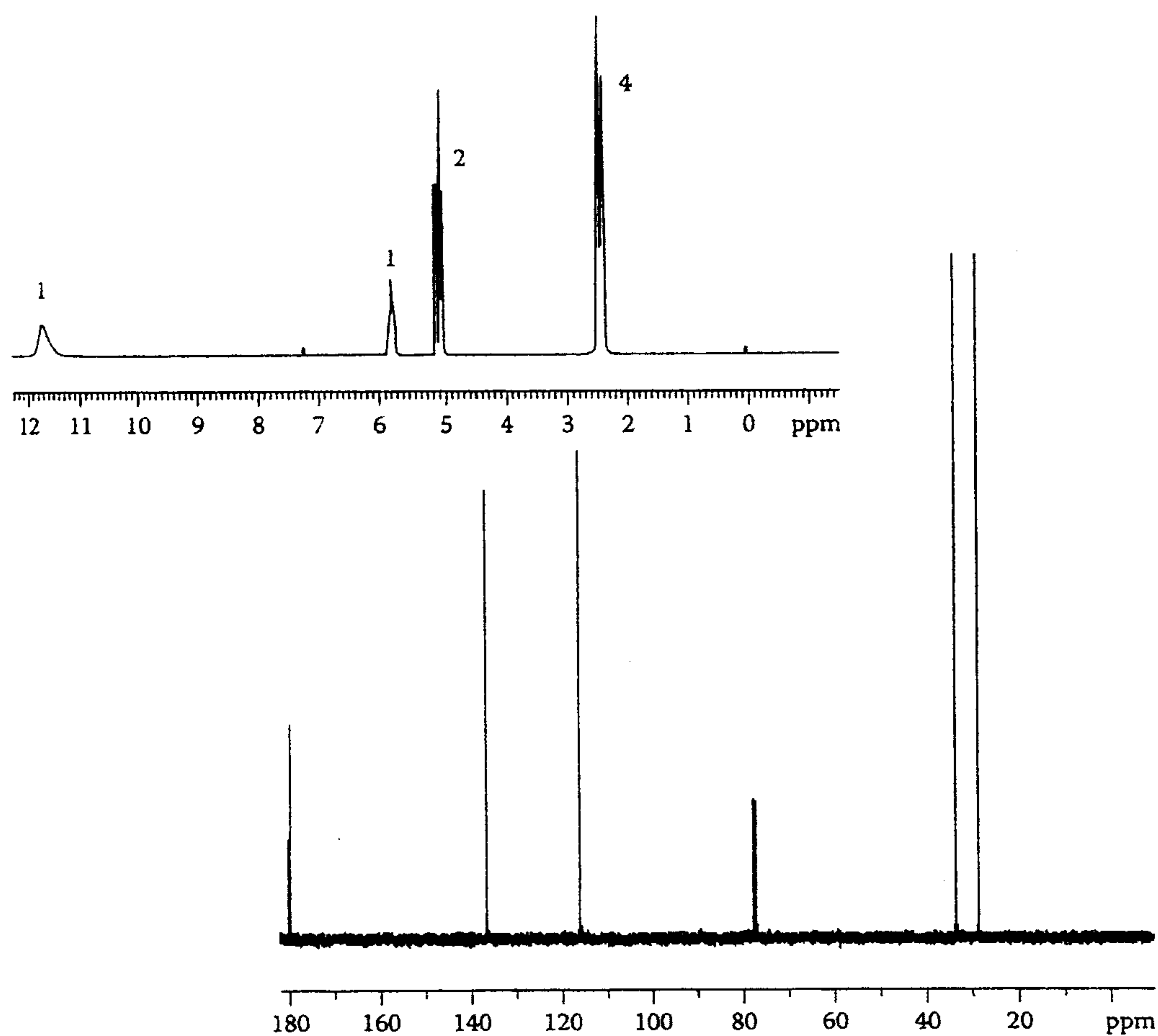
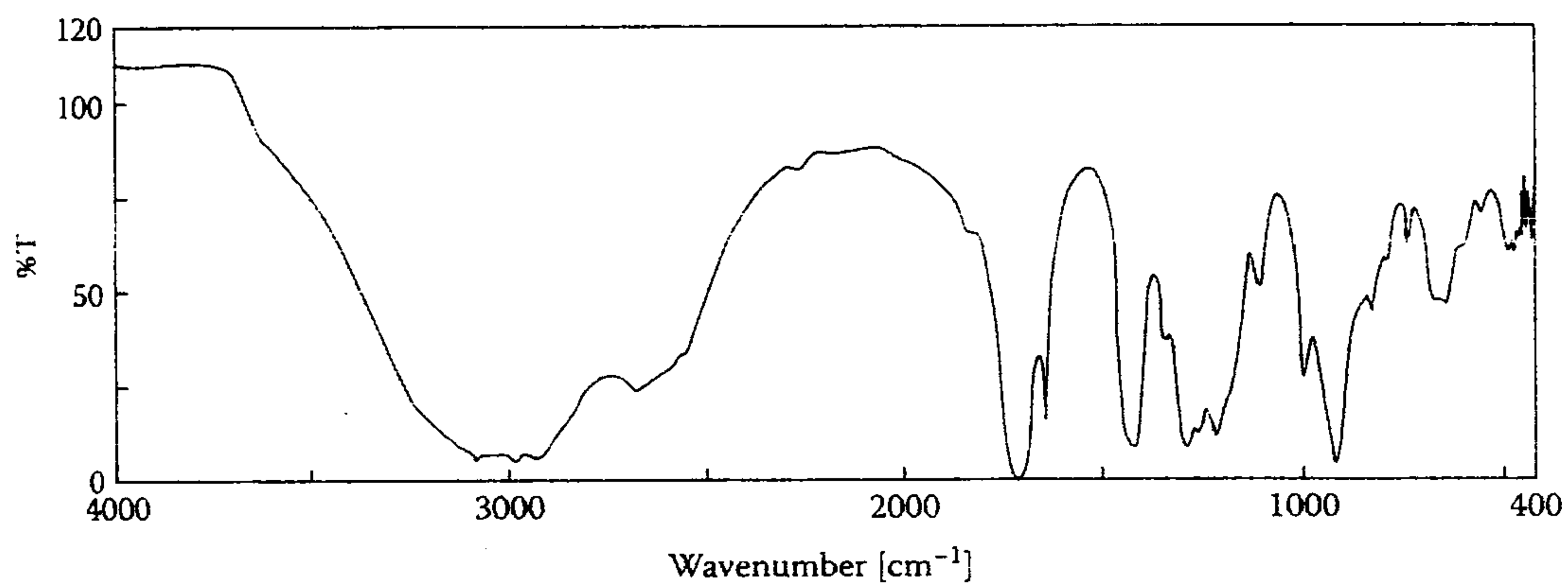
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*請在【答案卷】作答

9. Please identify $C_5H_8O_2$ structure according the following information: (5%)



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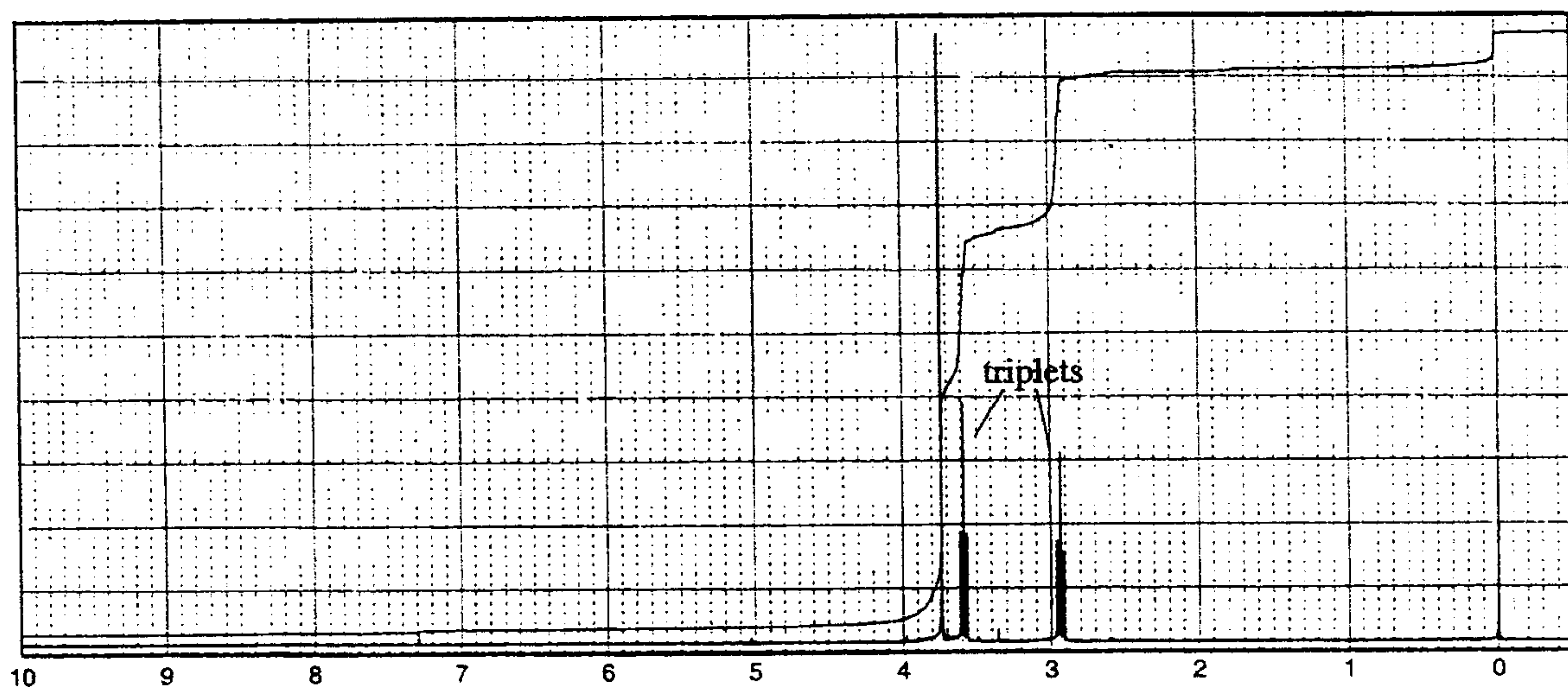
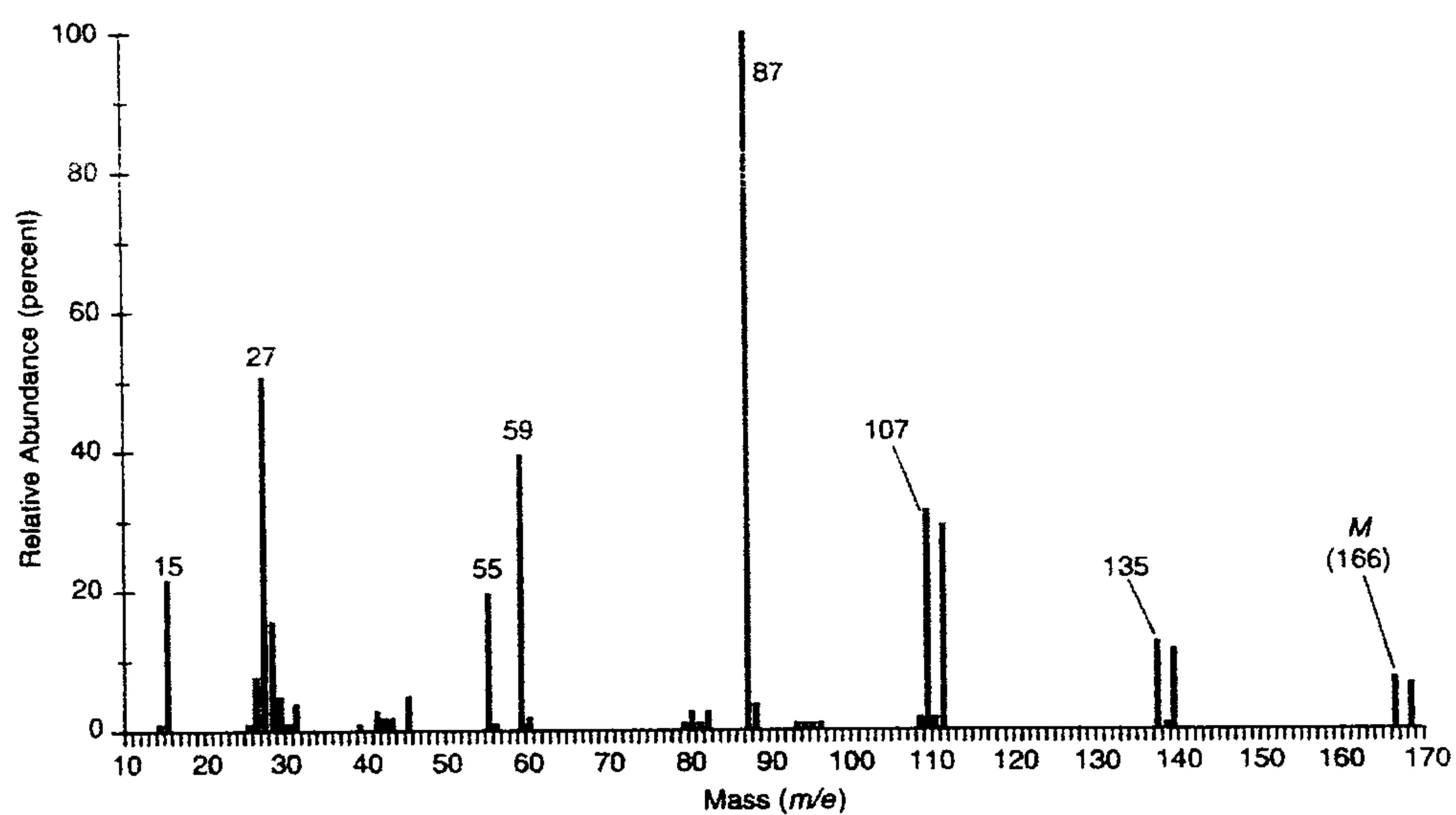
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*請在【答案卷】作答

10. Please identify $\text{C}_4\text{H}_7\text{BrO}_2$ structure according the following information: (5%)



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11. Select one answer for each of the following questions (1.5% each)

1) What is the order of decreasing reactivity of the following base positions in a nucleophilic reaction?

I. N-1 of Cytosine II. N-3 of Adenine III. N-7 of Guanine

(A) I, II, III (B) I, III, II (C) II, III, I (D) III, II, I

2) Which of the following bases is obtained by diazotization process?

(A) A to T (B) C to U (C) G to A (D) U to G

3) What is the charge on adenosine phosphate at the blood serum pH of 7.4?

(A) -3 (B) -2 (C) -1 (D) 0

4) Which of the following is the terminal amino acid in the original polypeptide based on three facts?

I. Upon hydrolysis the following proportions of amino acids are obtained:

1 Ala, 1 Gly, 2 Ile, 2 Phe, 1 Ser, and 2 Trp

II. Partial hydrolysis of the peptide gives a mixture of smaller peptides including Ala-Gly, Gly-Trp, Ile-Ile, Phe-Ile, Ser-Phe, Trp-Phe, Trp-Ser, and Ile-Ala

III. Treatment of the peptide with 2,4-dinitrofluorobenzene followed by hydrolysis gives *N*-(2,4-dinitrophenyl)tryptophan in the mixture of amino acids

(A) Trp (B) Ser (C) Phe (D) Ile

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- 5) How many triglycerides including stereoisomers are possible to have 2 different acyl groups?
- (A) 2 (B) 3 (C) 4 (D) 5
- 6) Triacylglycerols are rich in unsaturated fatty acids. Which of the following properties is responsible for the fact that triacylglycerols are usually liquids at room temperature??
- (A) *cis* unsaturated carbon-carbon bonds (B) Hydrogen bonds
(C) Hydrophobic interactions (D) Van der Waals attractions
- 7) When the following compounds are dissolved in water at the same concentrations, which one will have the lowest pH?
- (A) $\text{C}_6\text{H}_5\text{-CH}_2\text{N}(\text{CH}_3)_2$ (B) $\text{C}_6\text{H}_5\text{-CH}_2\text{N}^+(\text{CH}_3)_3 \text{ } ^-\text{OH}$
(C) $\text{C}_6\text{H}_5\text{-CH}_2\text{N}^+(\text{CH}_3)_3 \text{ } ^-\text{Cl}$ (D) $\text{C}_6\text{H}_5\text{-CH}_2\text{N}^+\text{H}(\text{CH}_3)_2 \text{ } ^-\text{Cl}$
- 8) Which of the following halides can be used in an acetoacetic synthesis of 2-hexanone?
- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (B) $\text{CH}_3(\text{C}=\text{O})\text{CH}_2\text{Cl}$
(C) $\text{CH}_2=\text{CHCH}_2\text{Cl}$ (D) $\text{CH}_3\text{CH}_2\text{Br} + \text{CH}_3\text{I}$
- 9) Carboxylic acids and amides usually have higher boiling points than esters and anhydrides. Which of the following properties is attributed to such fact?
- (A) Dipolar association (B) Conjugated functional groups
(C) Hydrogen bonding (D) Resonance stabilization

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10) Which of the following mixtures can be separated by treatment with aqueous NaOH?

- I. $\text{C}_6\text{H}_5\text{-OH}$ and $\text{C}_6\text{H}_5\text{-CH}_2\text{OH}$ II. $\text{C}_6\text{H}_5\text{-CO}_2\text{H}$ and $\text{C}_6\text{H}_5\text{-CH}_2\text{CO}_2\text{H}$
III. $\text{C}_6\text{H}_5\text{-CO}_2\text{H}$ and $\text{C}_6\text{H}_5\text{-CH}_2\text{OH}$ IV. $\text{C}_6\text{H}_5\text{-CO}_2\text{H}$ and $\text{C}_6\text{H}_5\text{-OH}$
(A) I, II (B) I, III (C) II, IV (D) III, IV

11) How many stereoisomers are possible for a D-aldohexose?

- (A) 2 (B) 3 (C) 8 (D) 16

12) Which of the following compounds reacts fastest with sodium hydroxide in water?

- (A) 1-chloro-4-methoxybenzene (B) 1-chloro-3-methoxybenzene
(C) 1-chloro-4-nitrobenzene (D) 1-chloro-3-nitrobenzene

13) The molecular weight of one repeating unit of a polymer of double-stranded DNA is 650, and the extinction coefficient of dsDNA at 260 nm is 6,670. How many milligrams of dsDNA in 1 mL give an absorbance of 0.5128 in a 1 cm cuvette?

- (A) 5 (B) 50 (C) 100 (D) 200

14) How many sets of hydrogen atom signals are there ^1H -NMR spectrum for 2-methylcyclohexene?

- (A) 3 (B) 4 (C) 5 (D) 6

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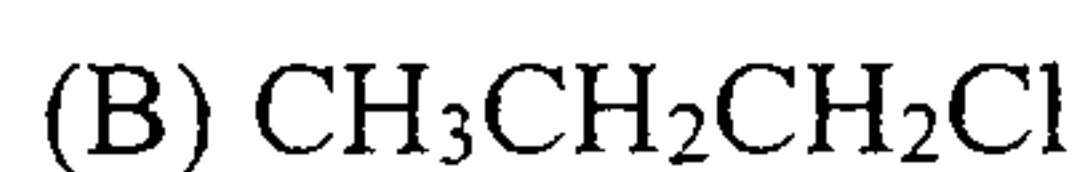
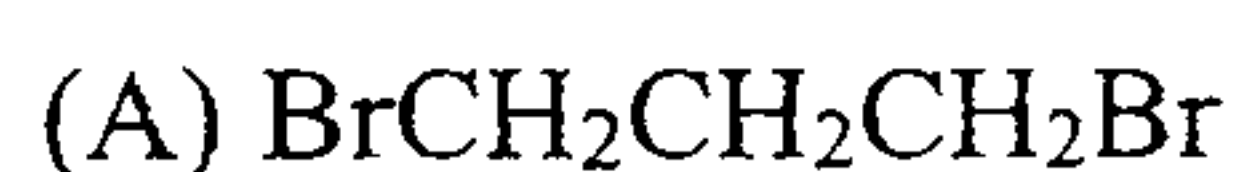
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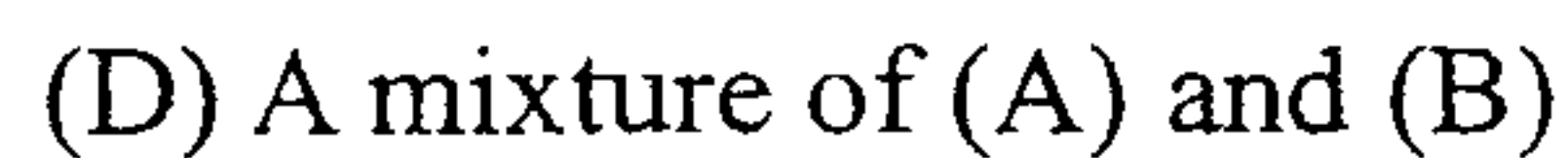
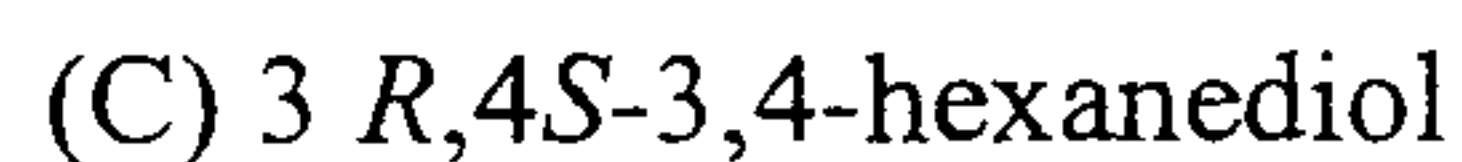
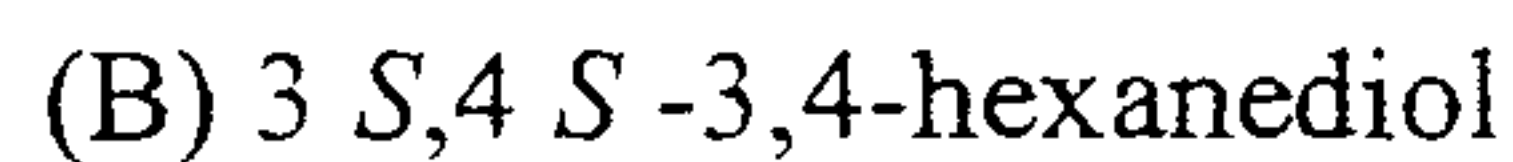
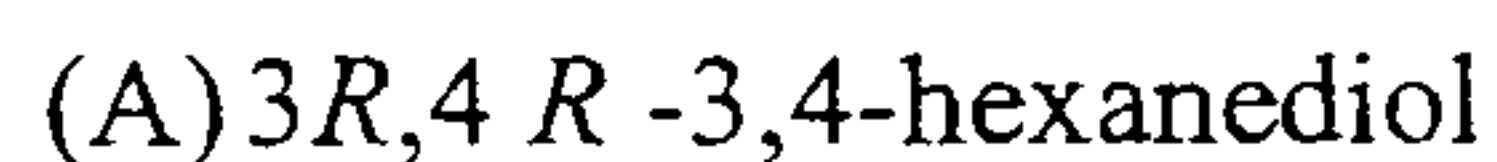
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*請在【答案卷】作答

15) The mass spectrum of compound A shows two peaks of nearly equal intensity at $m/e = 122$ and 124 , and a very small peak at $m/e = 123$. Which of the following is most likely formula of compound A?



16) What is the major product from reaction of *trans*-1,2-diethyloxirane with sodium hydroxide?



17) Arrange the following compounds in the order of increasing polarity.

I. Chloroform

II. Acetone

III. Water

IV. Carbon tetrachloride



18) Which of the following compounds contain stereoisomers?

I. 1-chloropentane

II. 2-chloropentane

III. 3-chloropentane

IV. 1,2-dichloropropane



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19) Which of the following substituents will activate a dienophile in a Diels-Alder reaction?

I. $-\text{C}=\text{O}$

II. $-\text{COOH}$

III. $-\text{C}(\text{CH}_3)_3$

IV. $-\text{OCH}_3$

V. $-\text{O}(\text{C}=\text{O})\text{CH}_3$

VI. $-(\text{C}=\text{O})\text{OCH}_3$

(A) I, II, VI

(B) III, IV, V

(C) I, II, V, VI

(D) III, IV

20) Which of the following reaction conditions would be used to prepare a vicinal diol from an alkene?

I. $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$

II. cold dilute KMnO_2

III. $\text{OsO}_4 + \text{H}_2\text{O}_2$

IV. $\text{O}_3, (\text{CH}_3)_2\text{S}$

(A) I, II

(B) II, III

(C) III, IV

(D) II, IV