

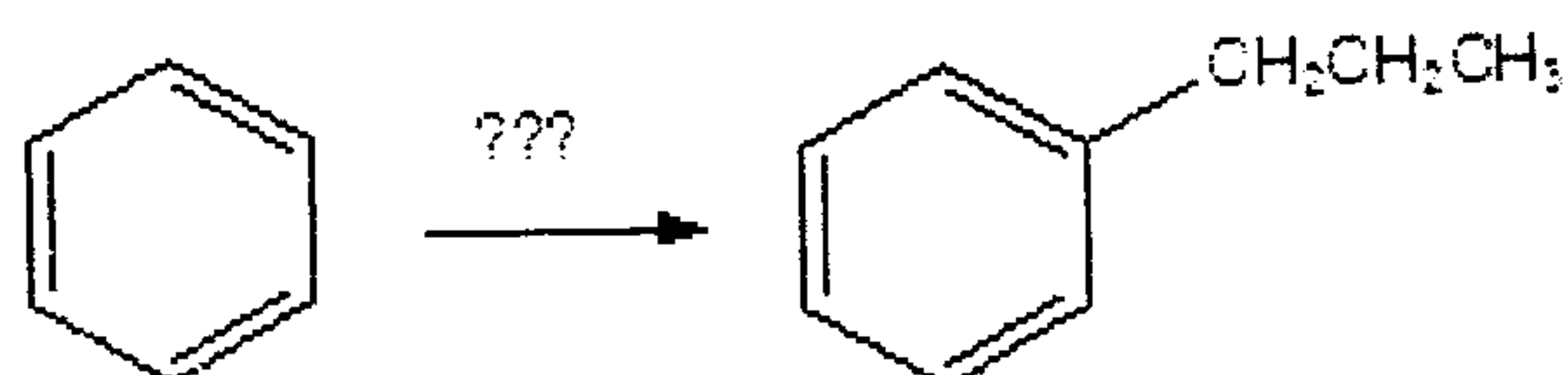
國立清華大學101學年度碩士班入學考試命題紙  
生醫工程與環境科學系(0522)  
甲組 (分子生醫光電組)

科目有機化學 科目代碼 2204

共 15 頁第 1 頁

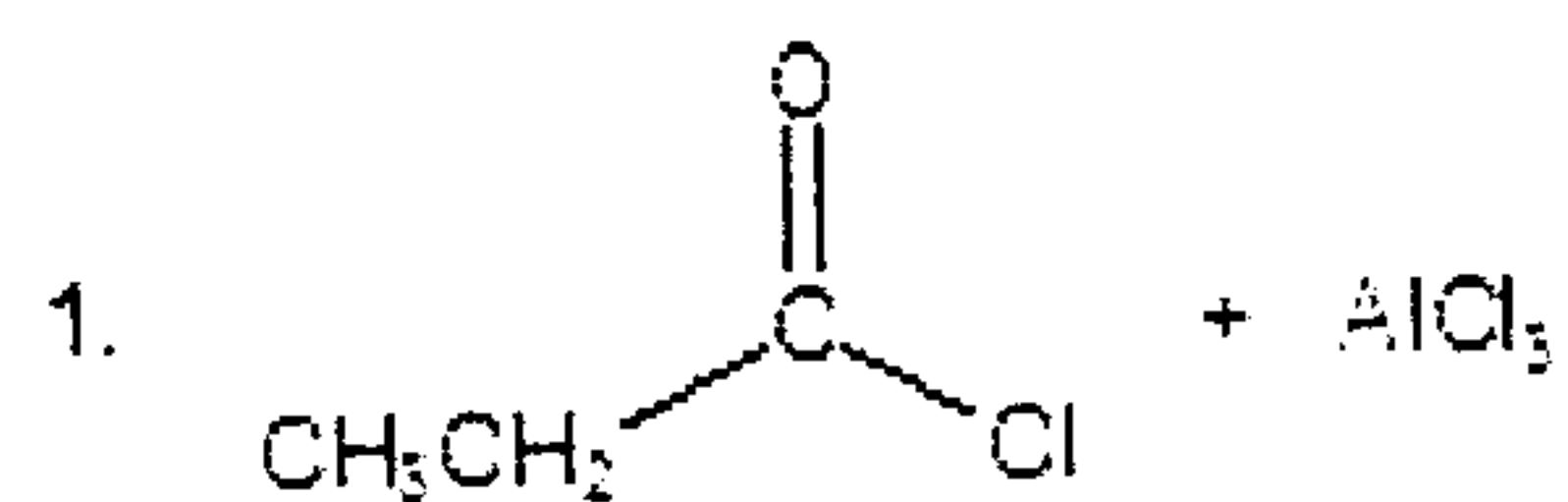
第一部分 選擇題 (No. 1-15) 請在答案卷作答  
單選(第1題除外)每題2分 共30分

1) Identify the condition(s) that will not work for the following reaction.



A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{H}_2\text{SO}_4$

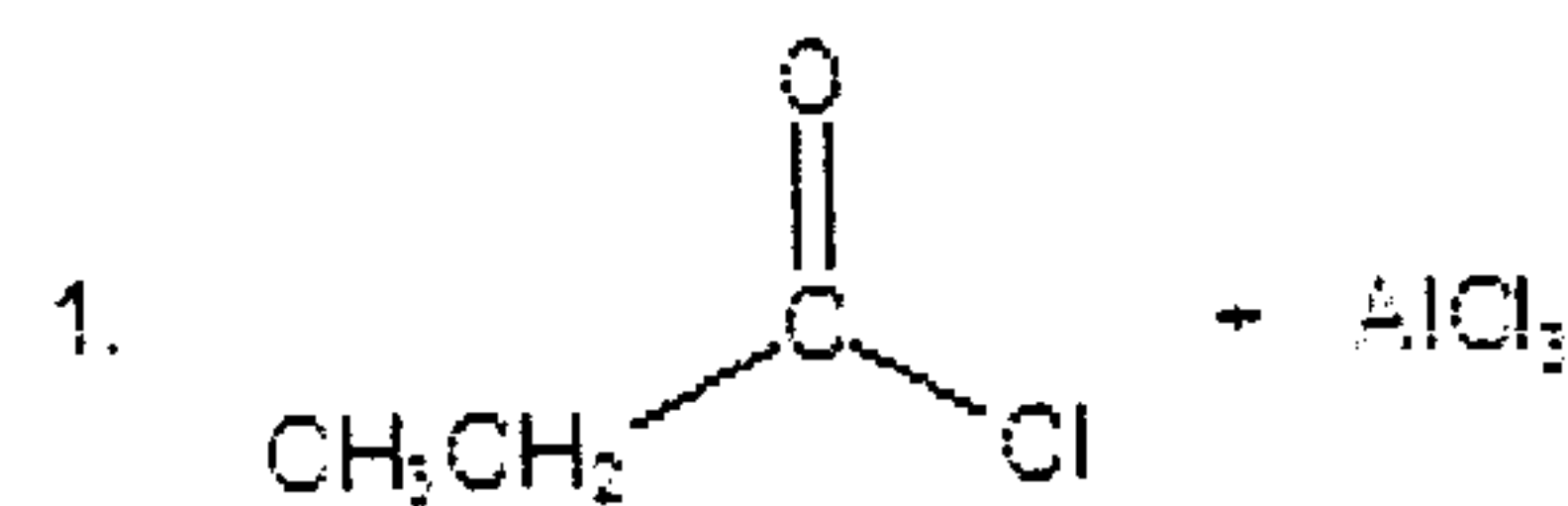
B)



2.  $\text{H}_2$ , Pd/C

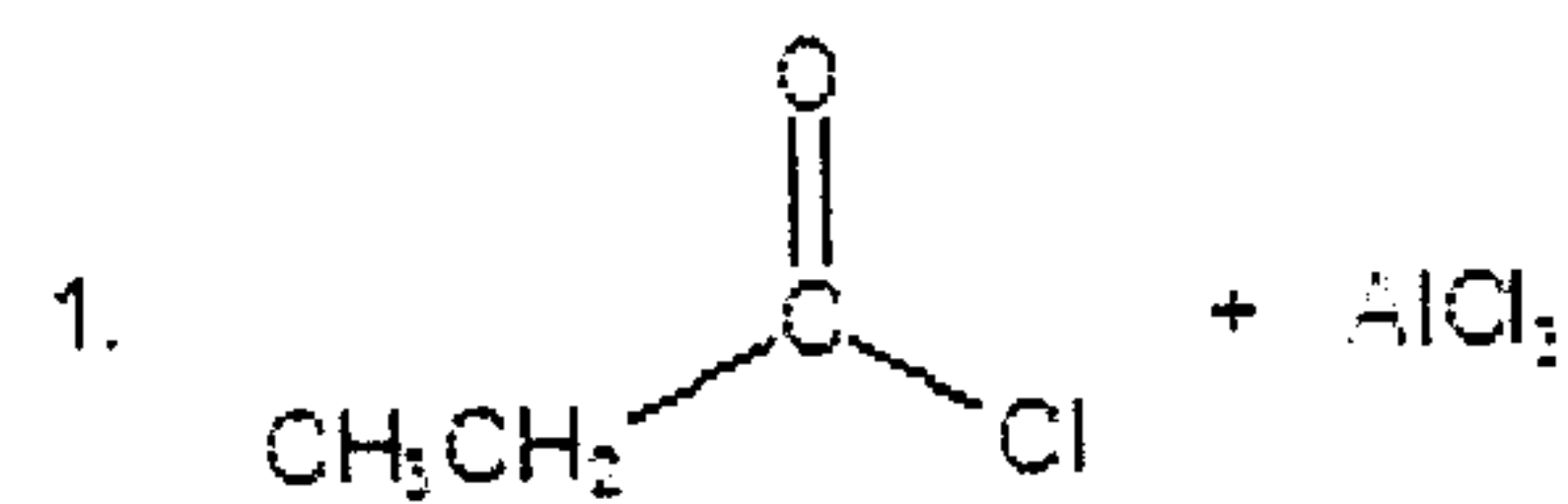
C)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$  +  $\text{AlCl}_3$

D)



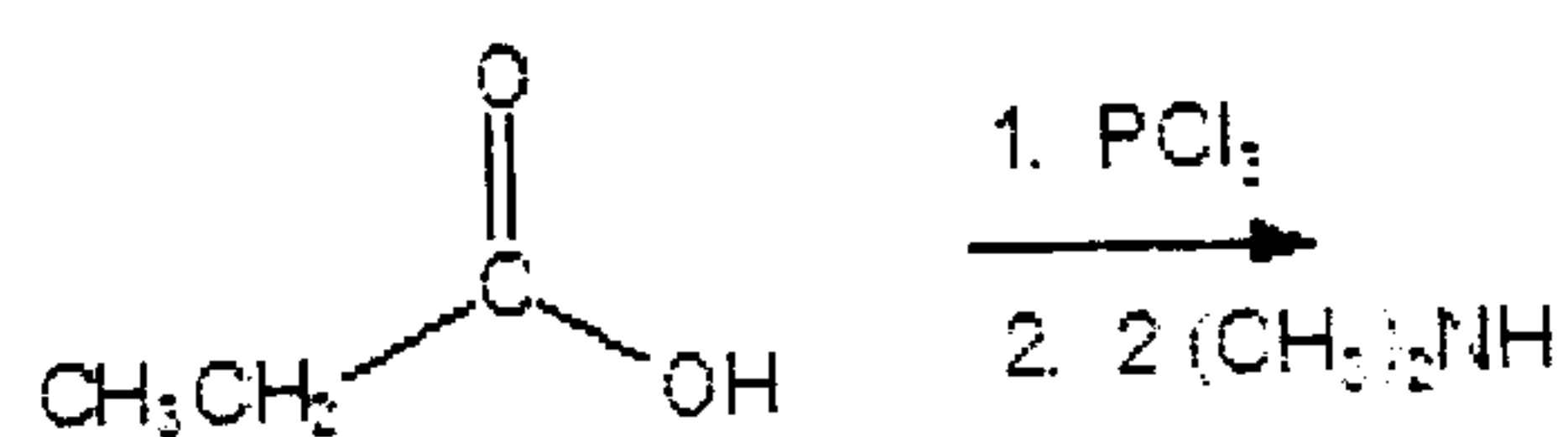
2.  $\text{Zn(Hg)}$ ,  $\text{HCl}$ , heat

E)



2.  $\text{H}_2\text{NNH}_2$ ,  $\text{KOH}$ , heat

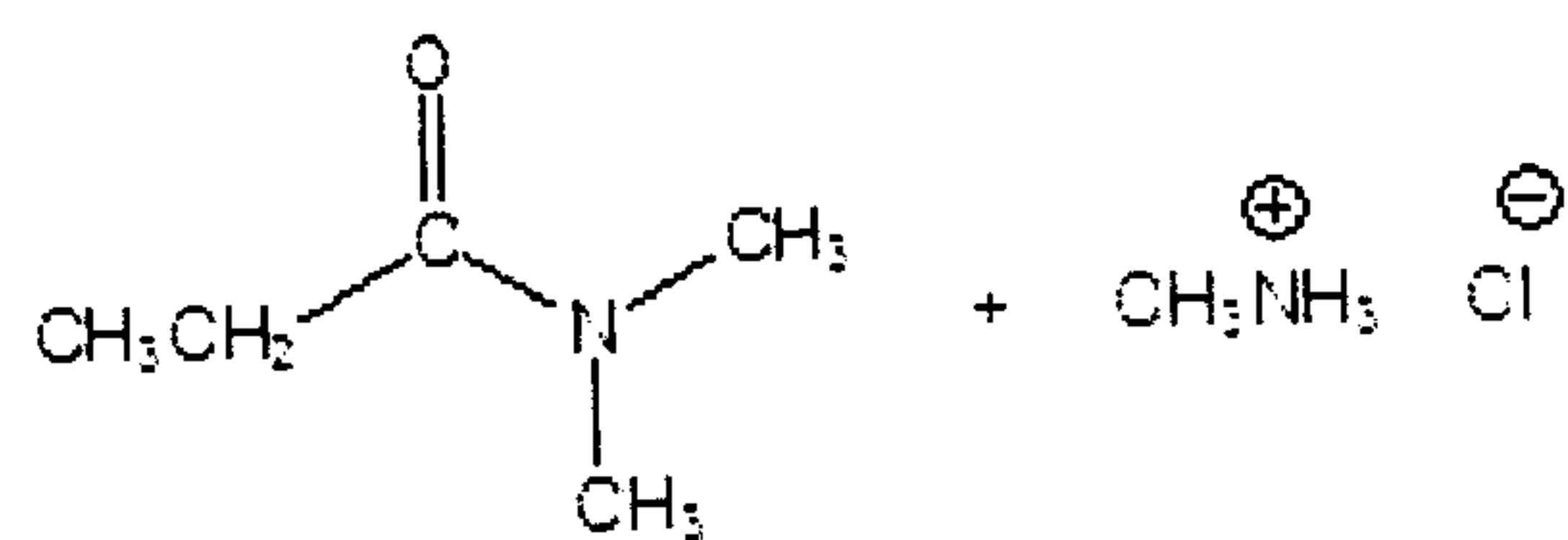
2) Give the product of the reaction.



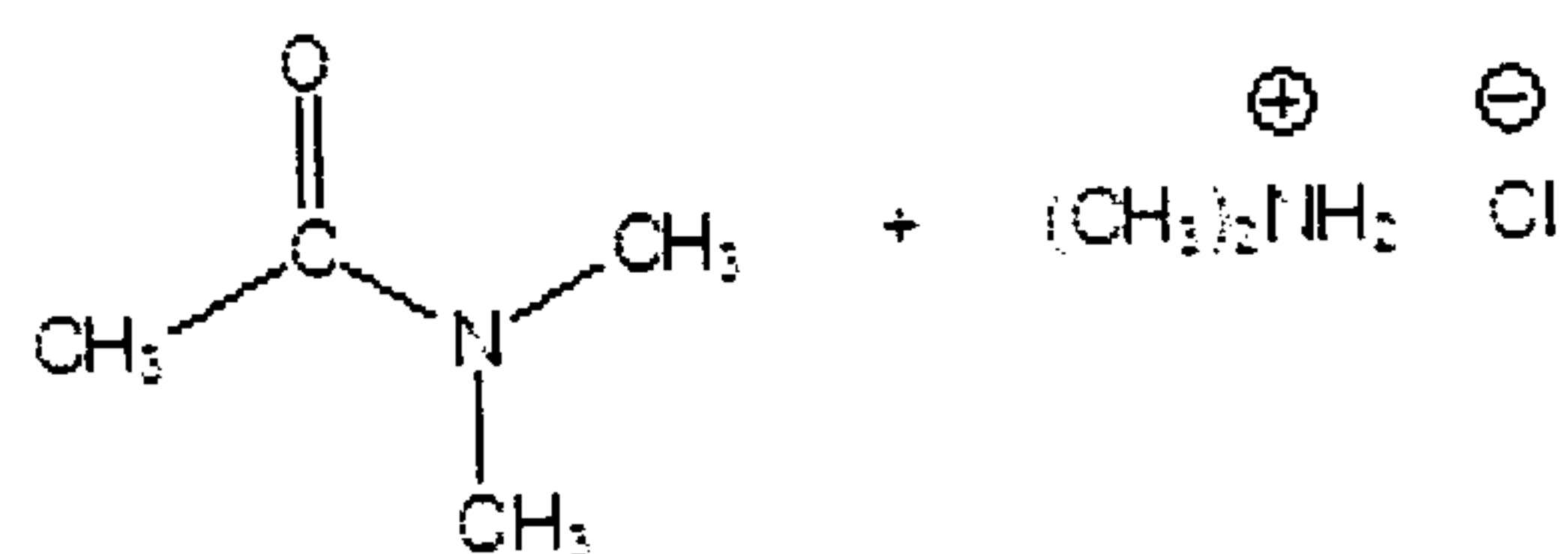
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共 15 頁第2頁

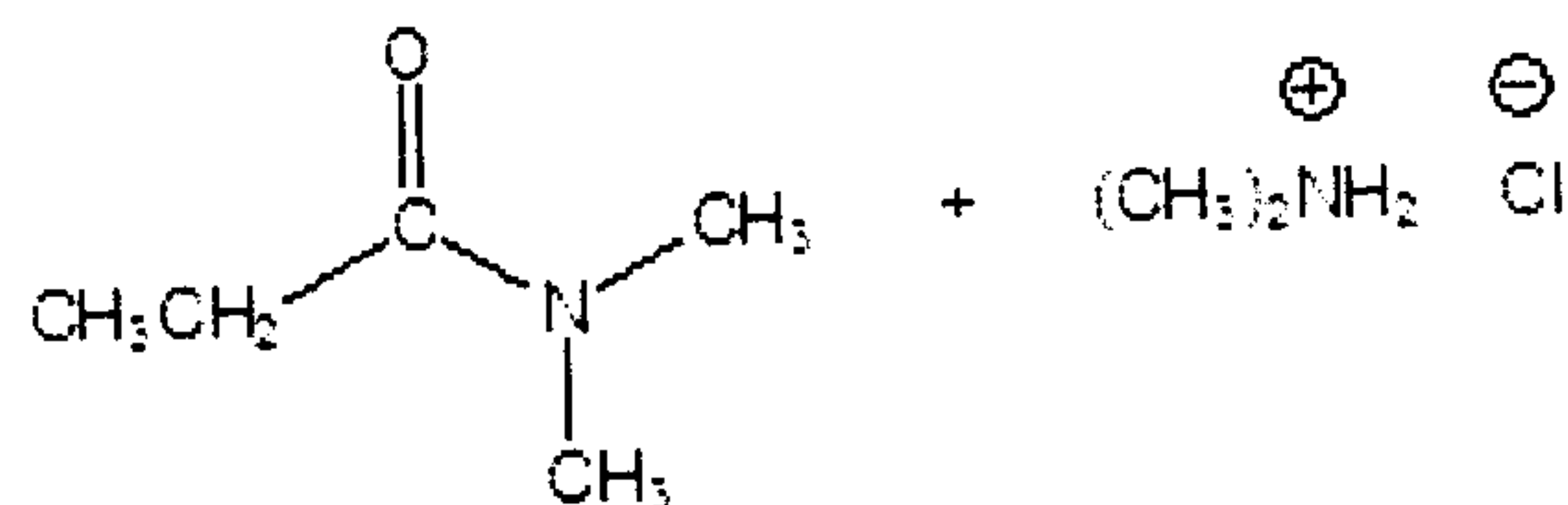
A)



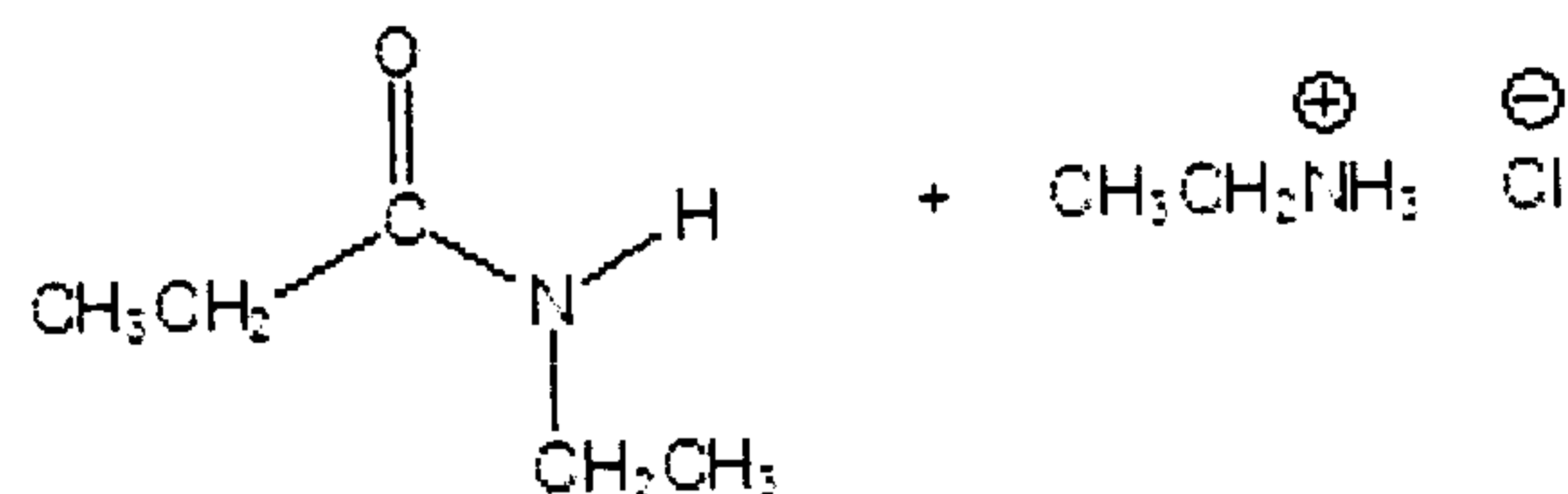
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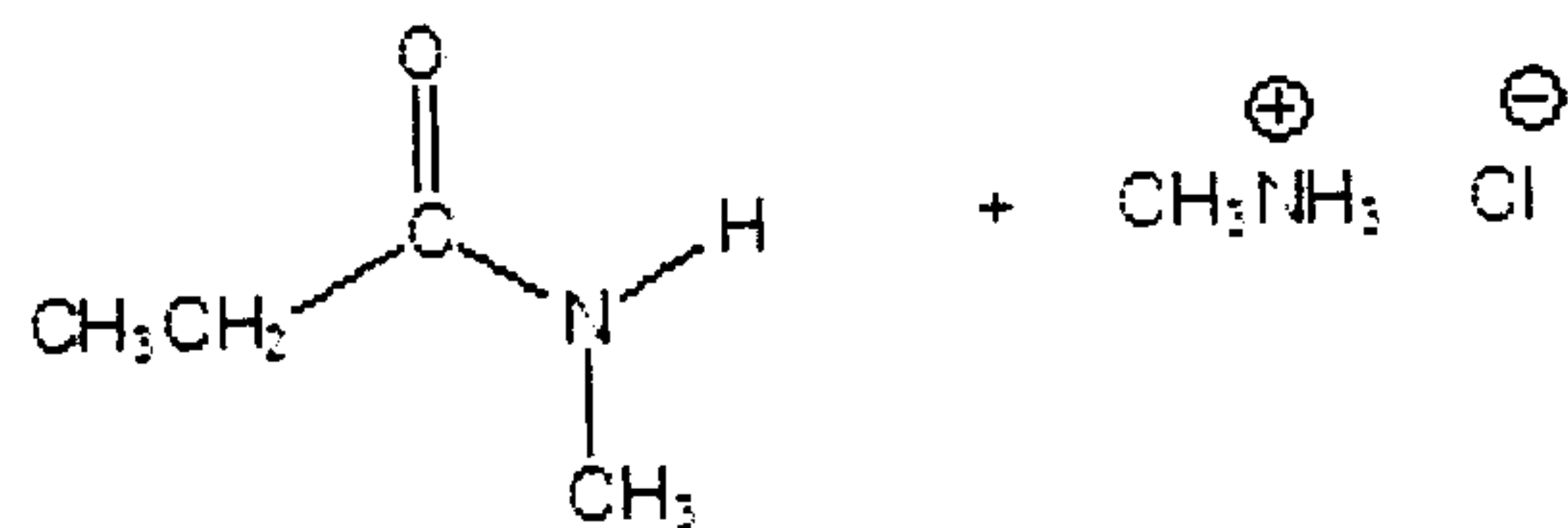
C)



D)



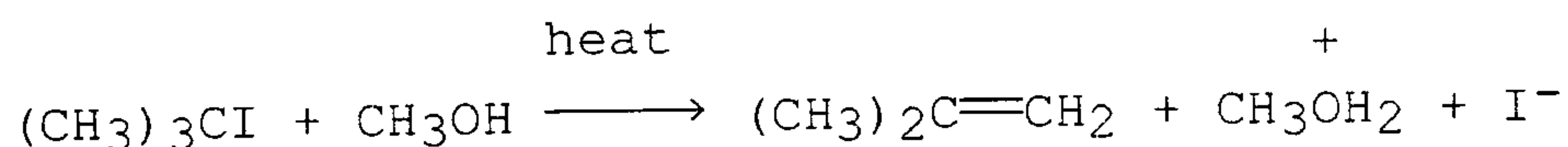
E)



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 共 15 頁第3頁

3) Consider the following experimental data for the rate of the reaction given below:

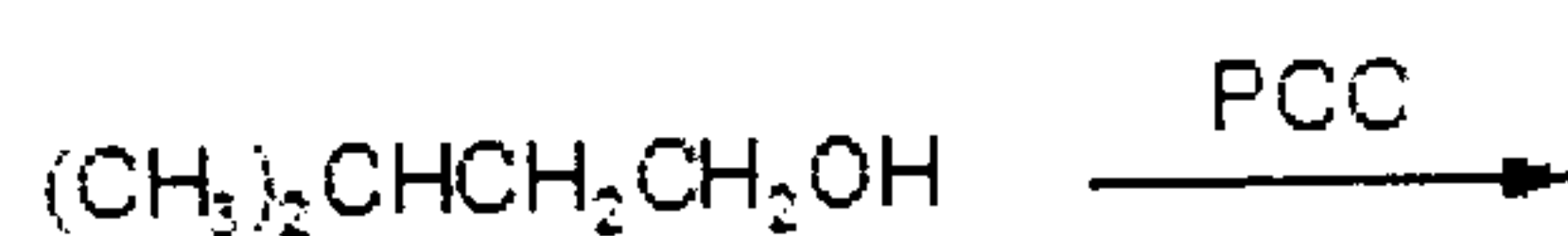


Experiment #1	[Alkyl Halide]	[Base]	Rate
1	0.01	0.01	1
2	0.02	0.01	2
3	0.01	0.02	1

What is the mechanism for the reaction?

- A) first order, S<sub>N</sub>1
- B) first order, E1
- C) first order, E2
- D) first order, S<sub>N</sub>2
- E) none of the above

4) Give the major product for the following reaction.



- A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
- B)  $(\text{CH}_3)_2\text{CHCH}_2\text{COOH}$
- C)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
- D)  $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$
- E) no reaction

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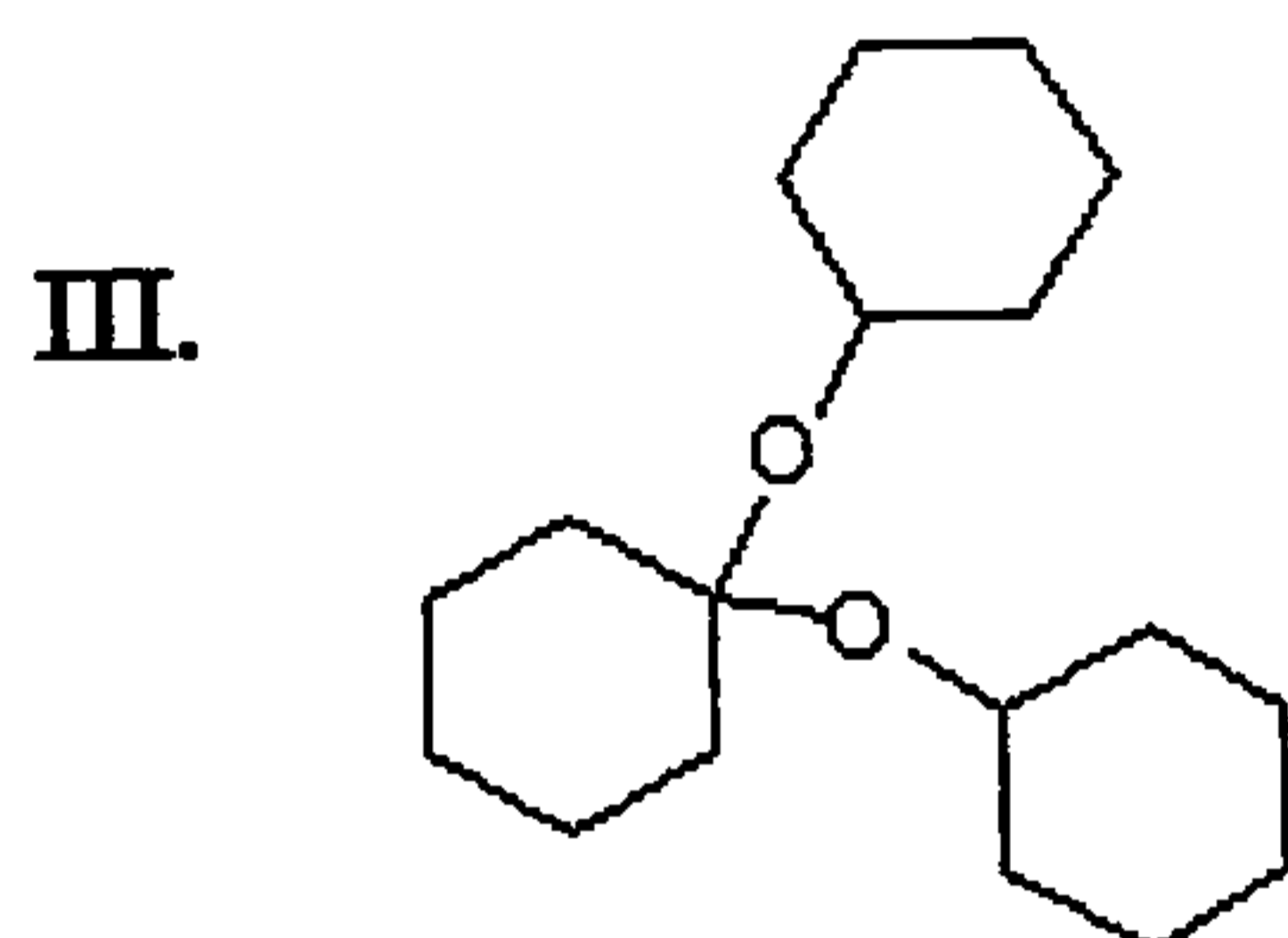
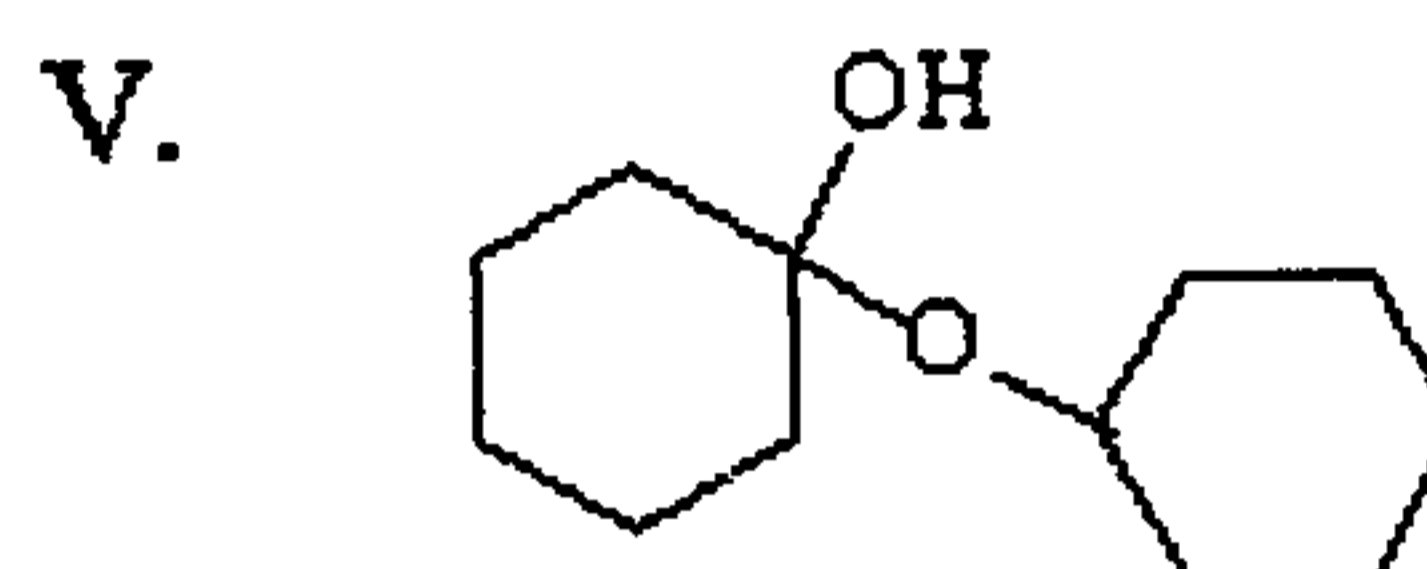
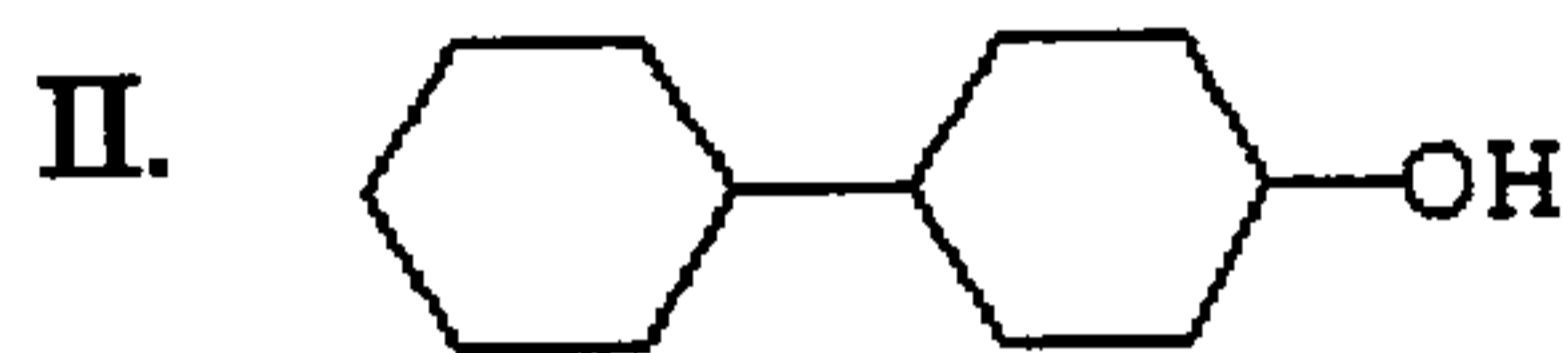
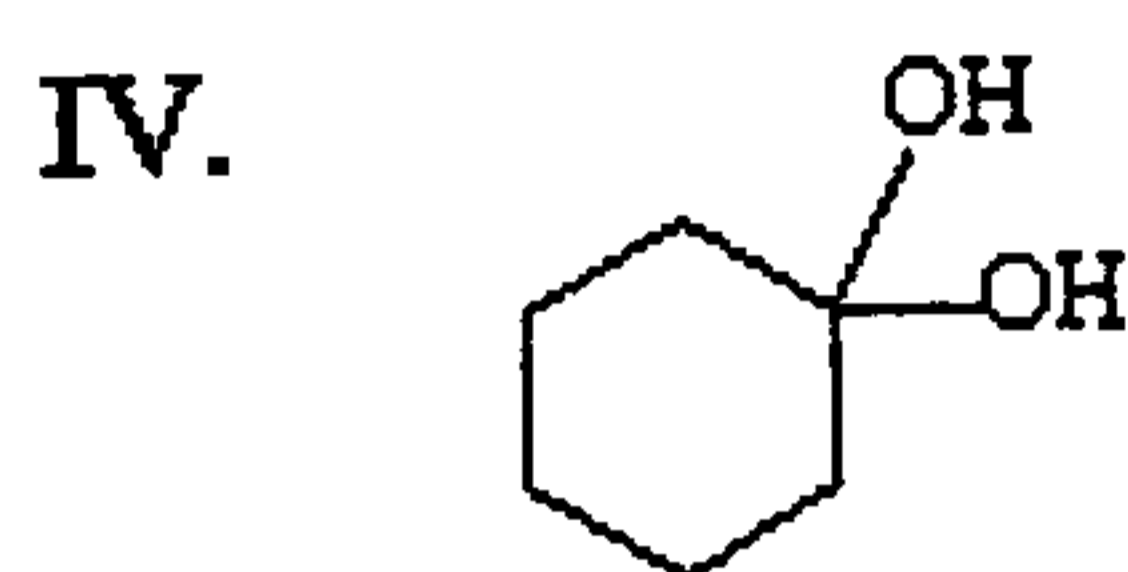
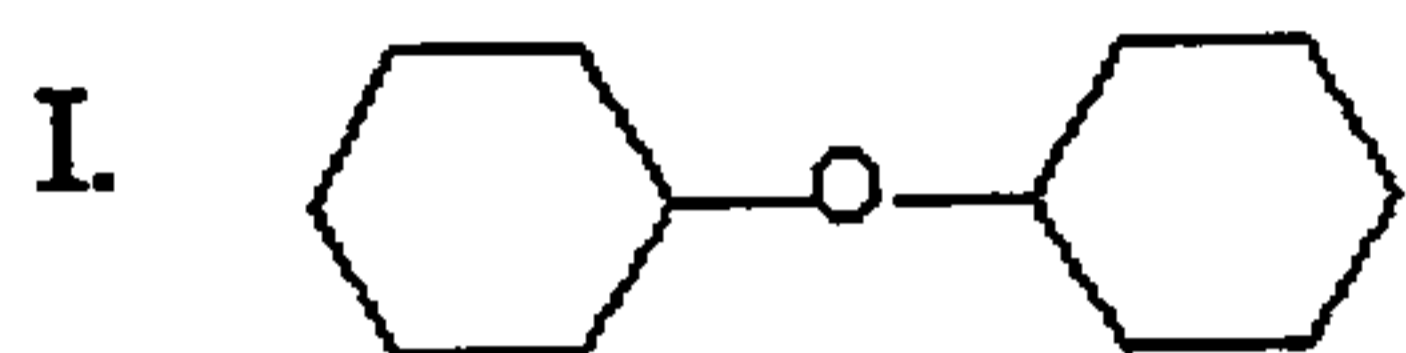
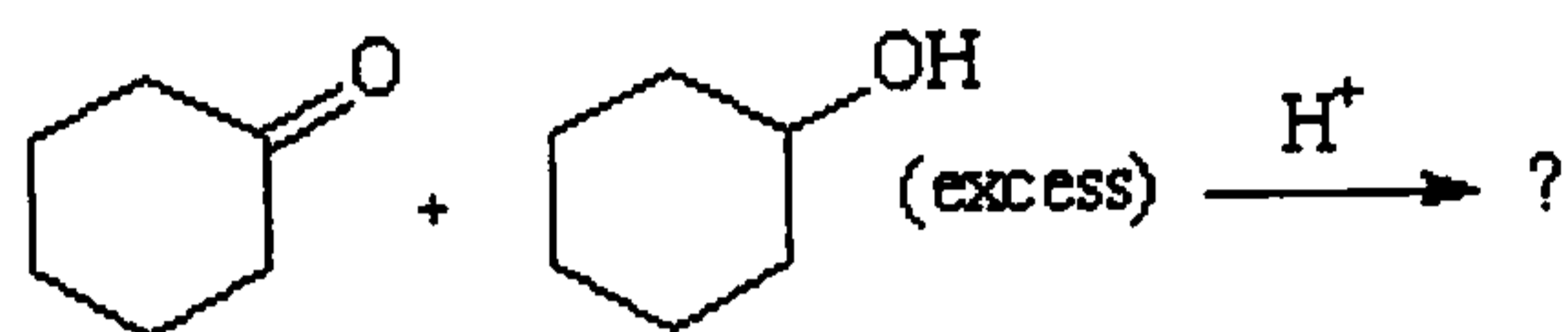
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5) What is the major product of the following reaction?



A) I

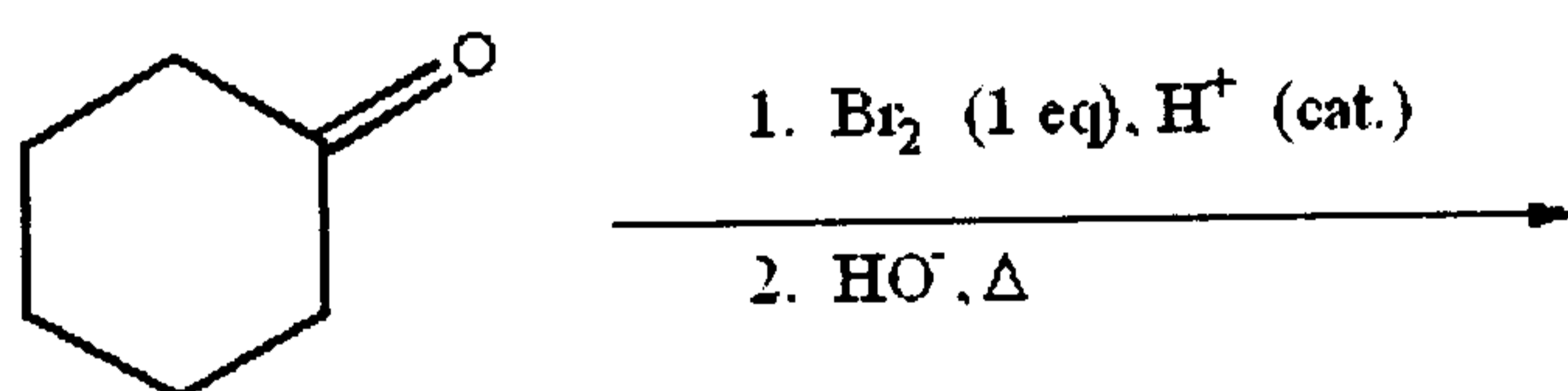
B) II

C) III

D) IV

E) V

6) Identify the major organic product of the following sequence.



A) 2-cyclohexenone

B) 4-bromocyclohexanone

C) 3-bromocyclohexanone

D) 4-hydroxycyclohexanone

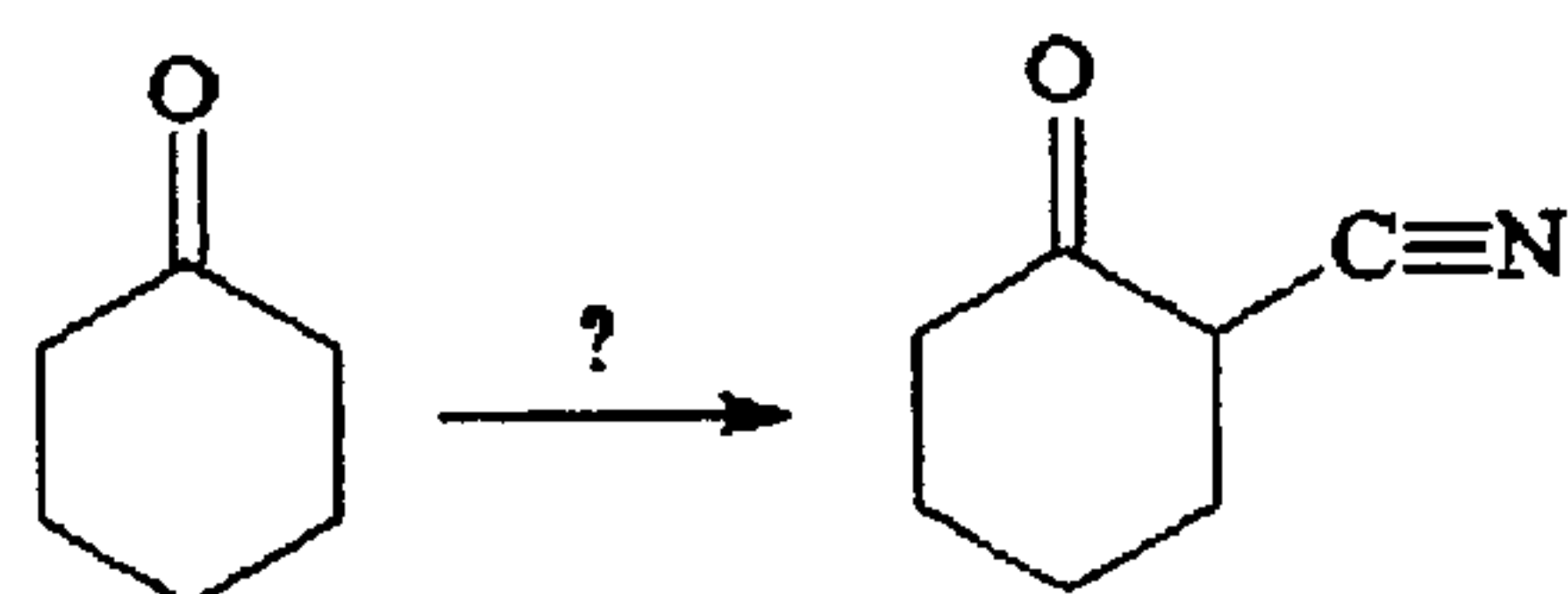
E) 3-hydroxycyclohexanone

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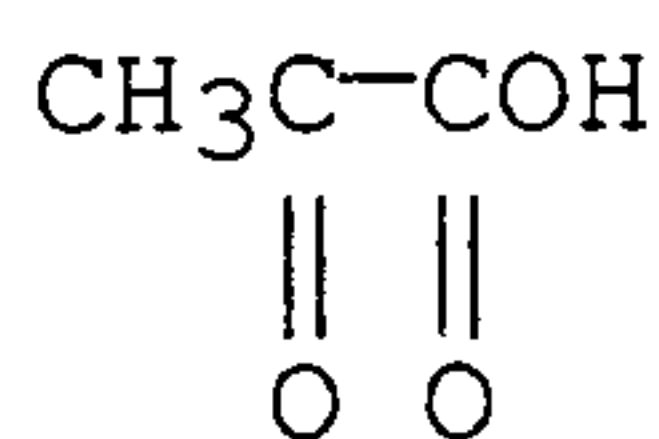
7) How would you accomplish the following conversion?



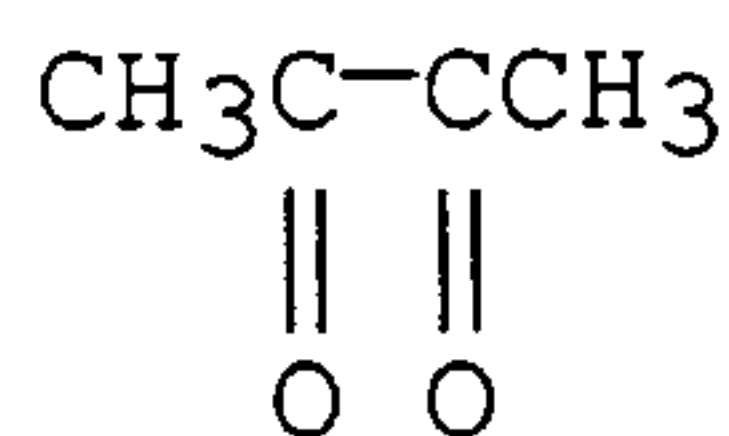
- A) HBr; NaC≡N
- B) H<sup>+</sup>/H<sub>2</sub>O; HC≡N
- C) -OH/NaC≡N
- D) Br<sub>2</sub>/H<sup>+</sup>, H<sub>2</sub>O; NaC≡N
- E) LiAlH<sub>4</sub>; HC≡N; KMnO<sub>4</sub>

8) Which of the following compounds has the most stable enol tautomer?

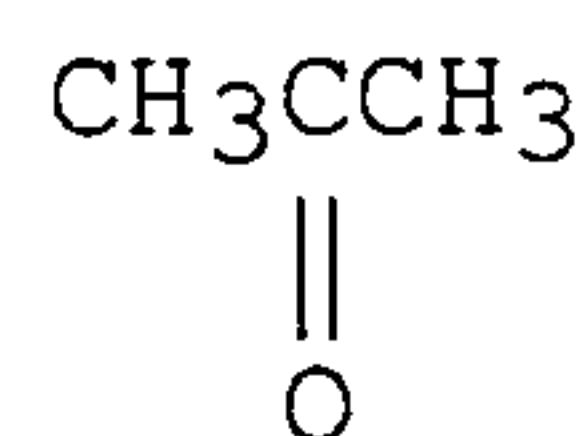
A)



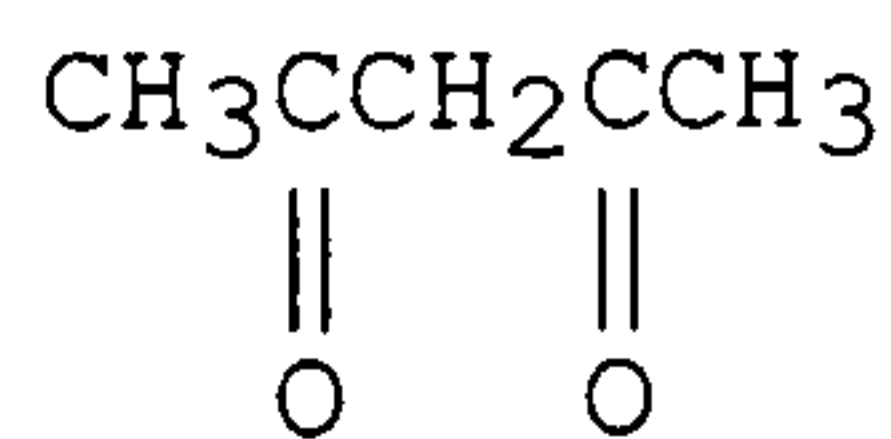
B)



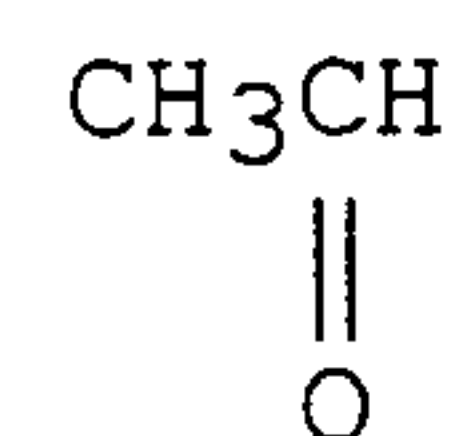
C)



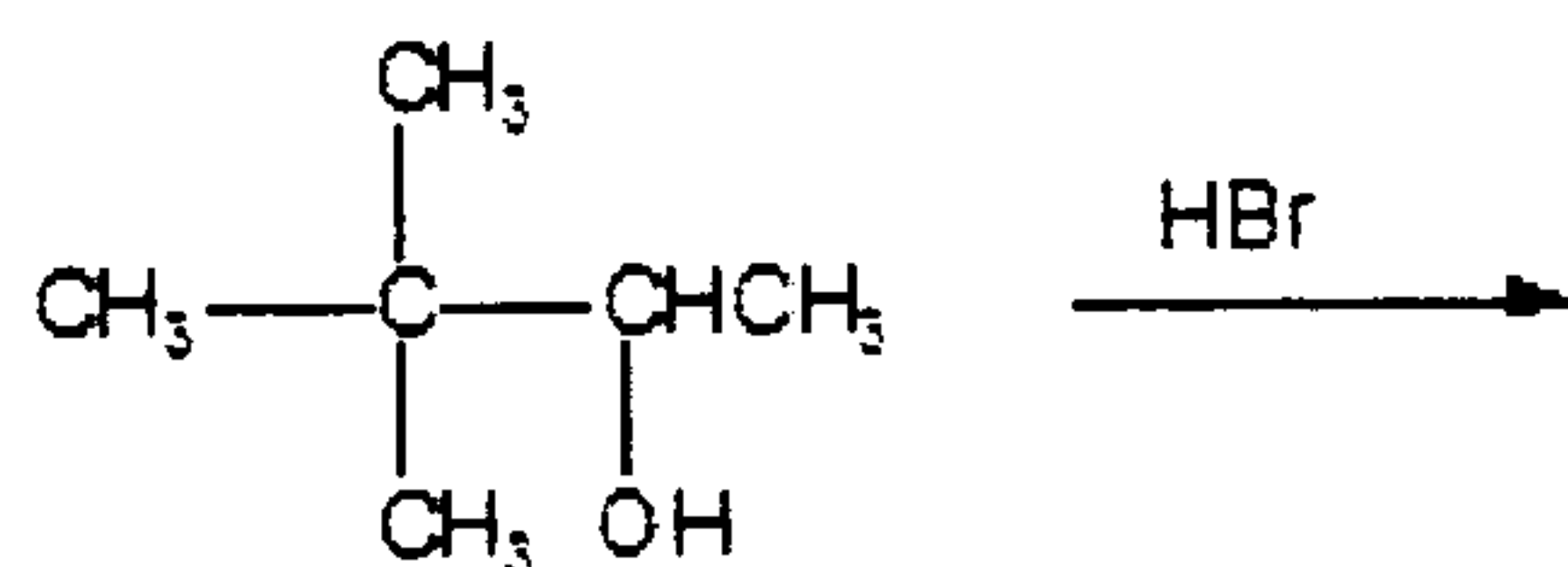
D)



E)



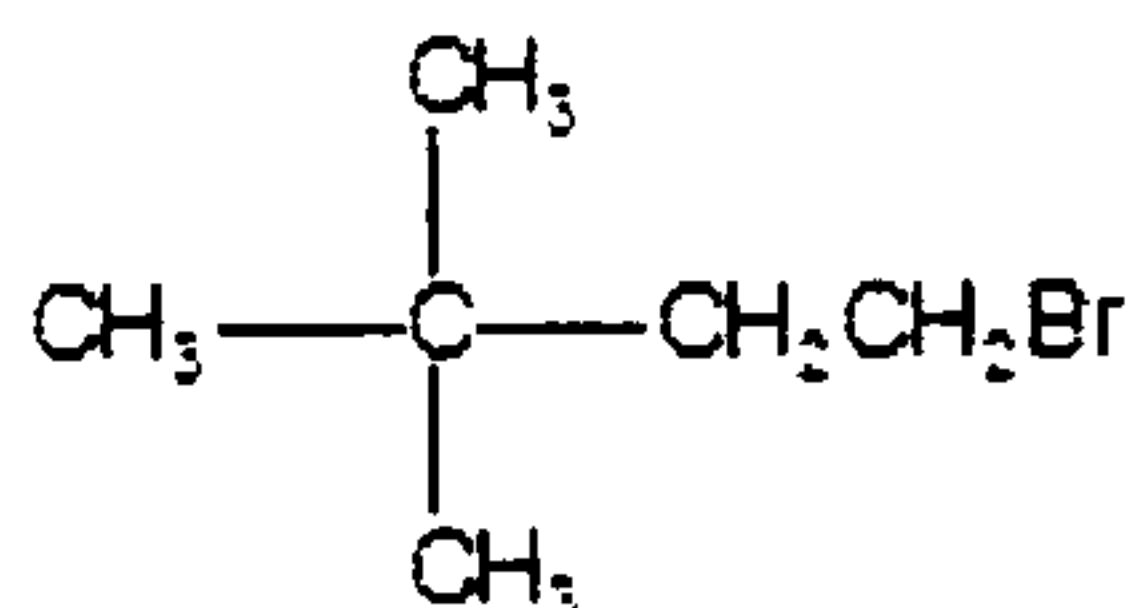
9) Give the major product for the following reaction.



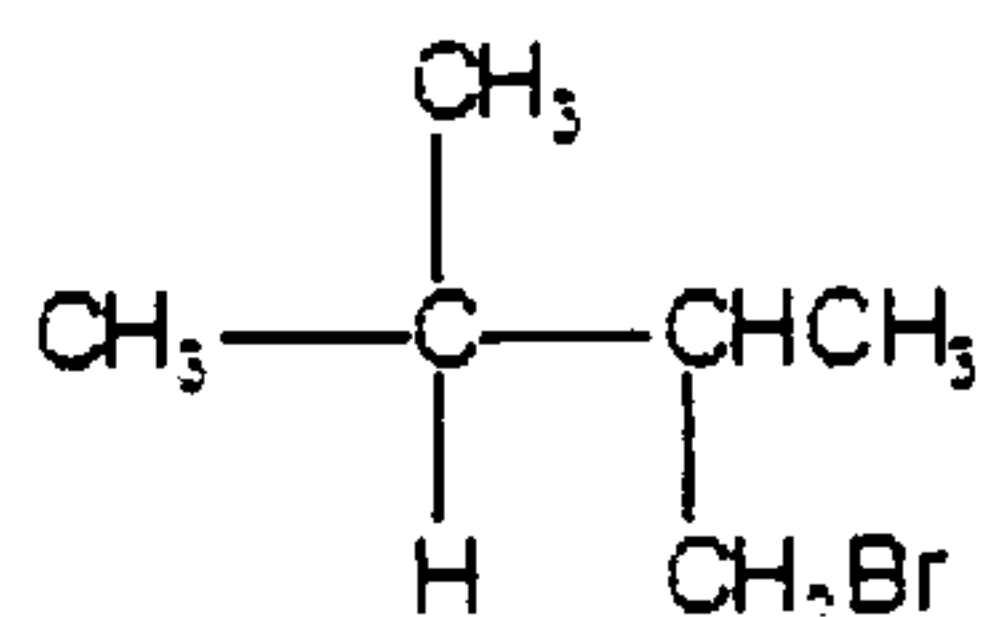
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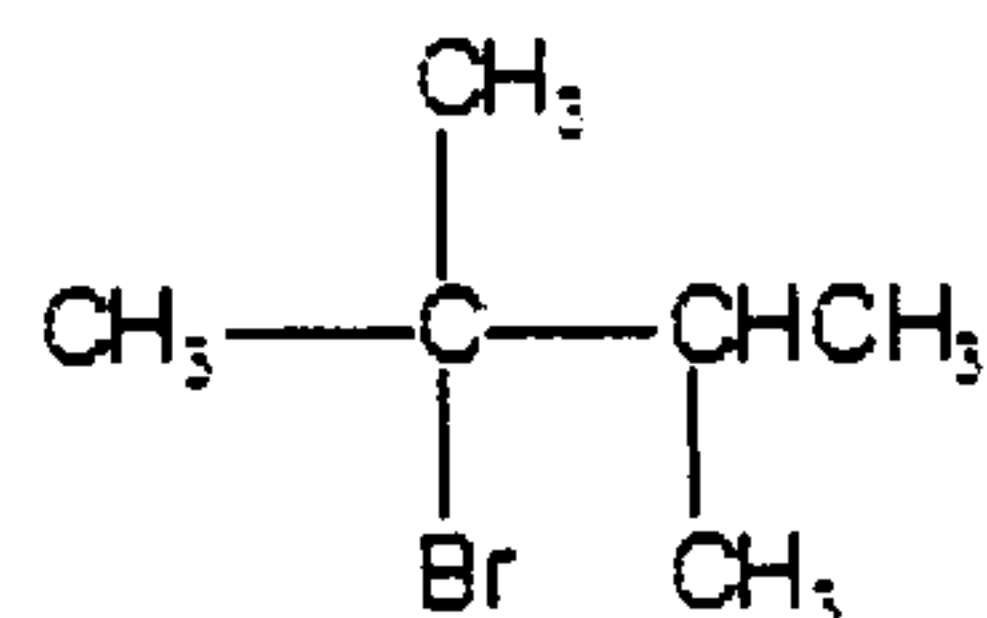
A)



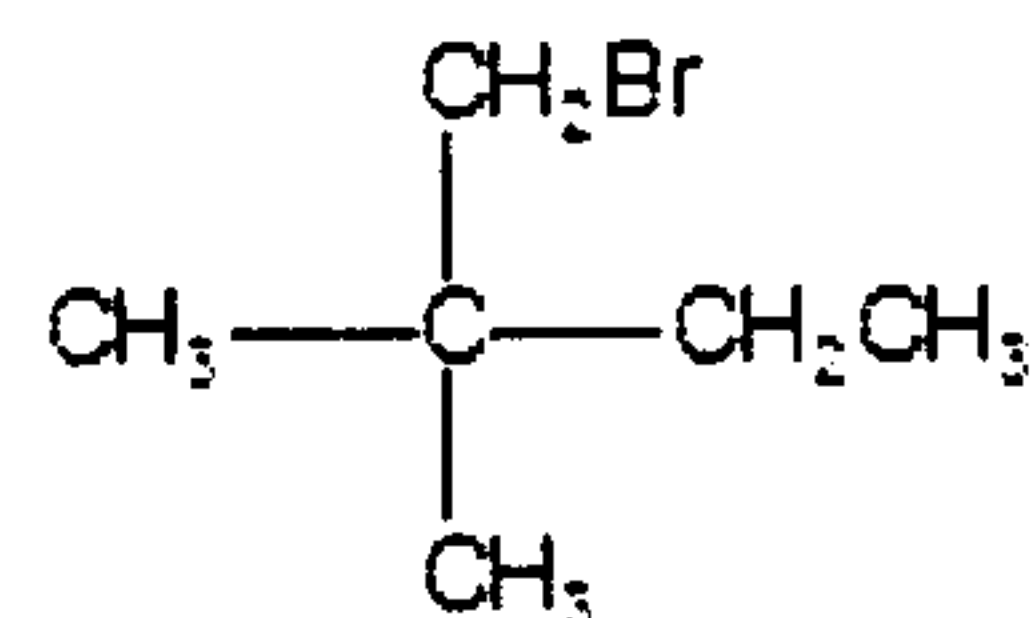
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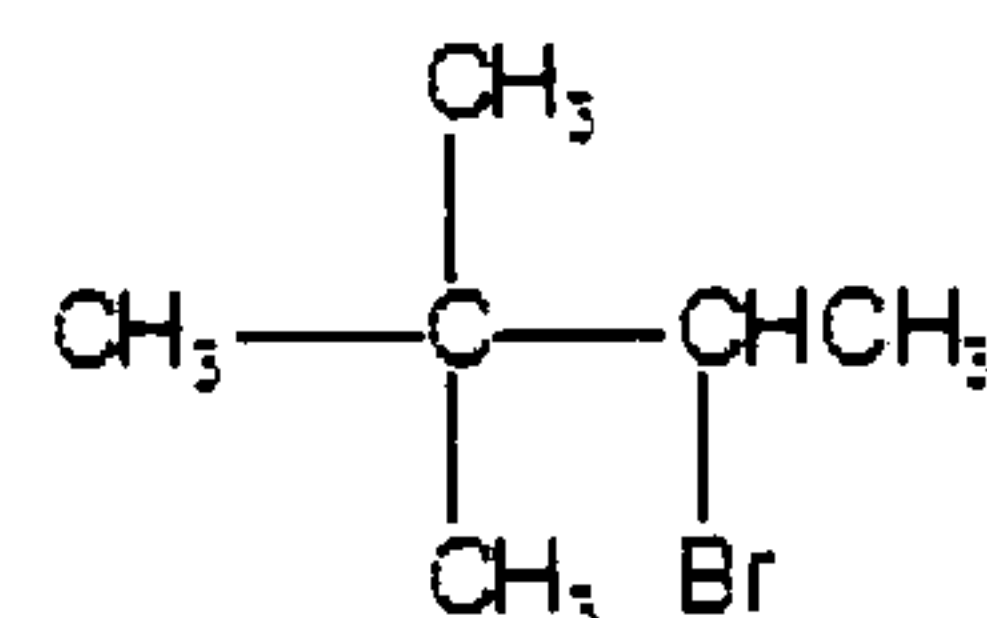
C)



D)



E)



10) Which of the sequences works best to accomplish the following conversion?



- A) 1.  $\text{NaNH}_2$  2.  $\text{H}_3\text{O}^+$   
 B) 1.  $\text{NaCN}$ ,  $\text{HCl}$  2.  $\text{H}_2$ ,  $\text{Pt}$   
 C) 1.  $\text{H}_2\text{NNH}_2$ ,  $\text{H}^+$  2.  $\text{H}_3\text{O}^+$   
 D) 1.  $\text{NH}_3$ ,  $\text{H}^+$  2.  $\text{H}_2$ ,  $\text{Pt}$   
 E) 1.  $\text{H}_2\text{NCH}_2\text{MgBr}$  2.  $\text{H}_3\text{O}^+$

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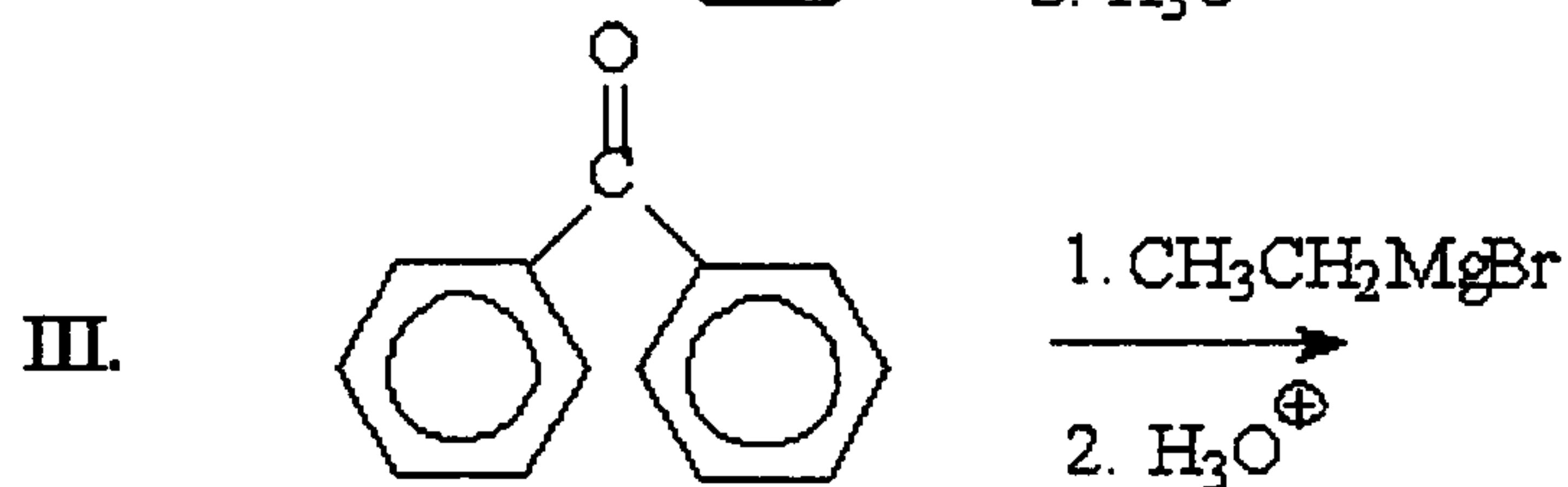
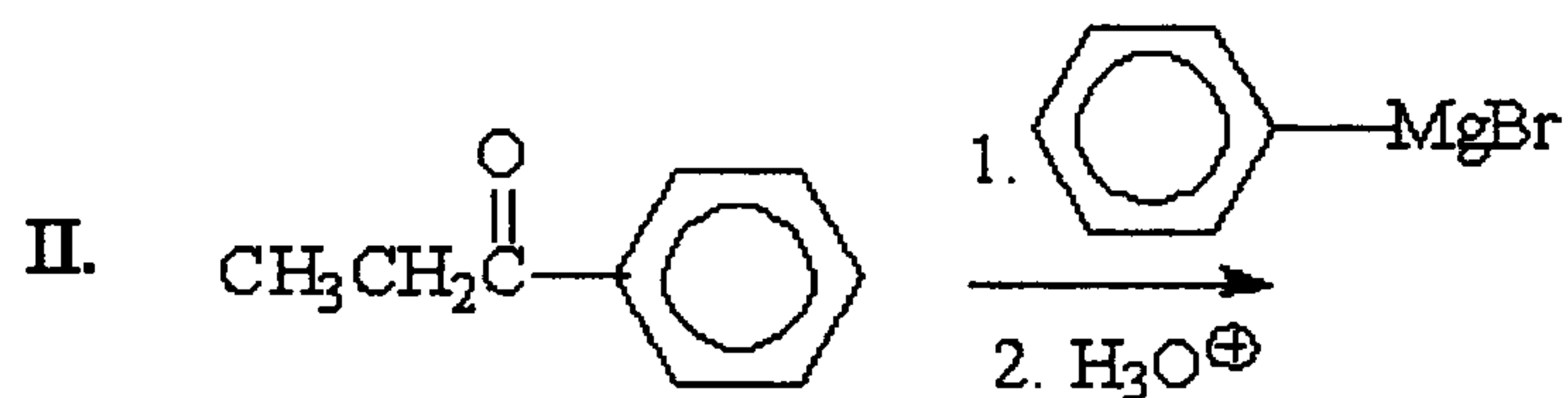
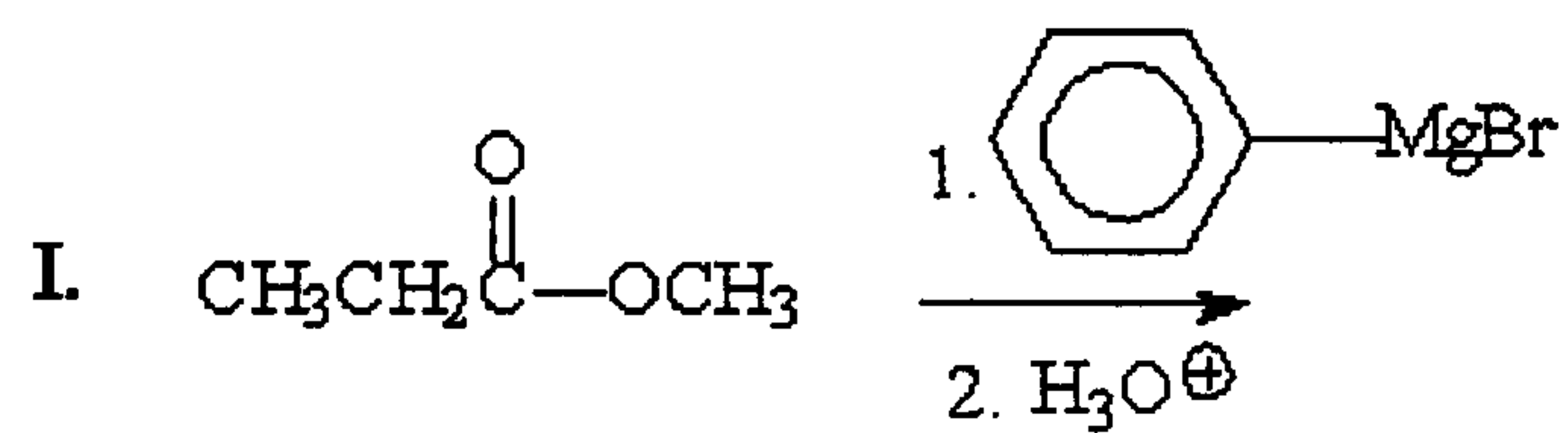
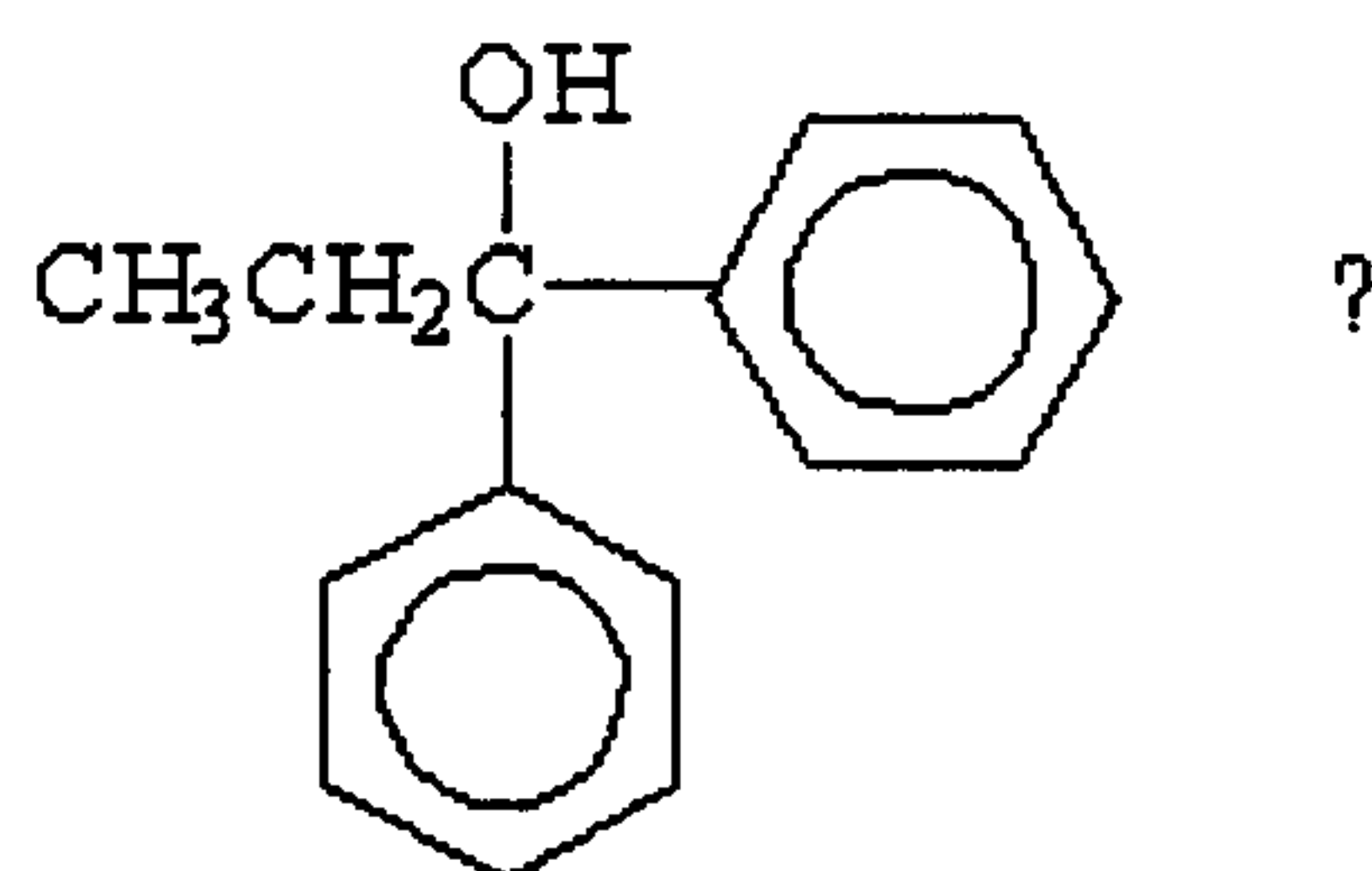
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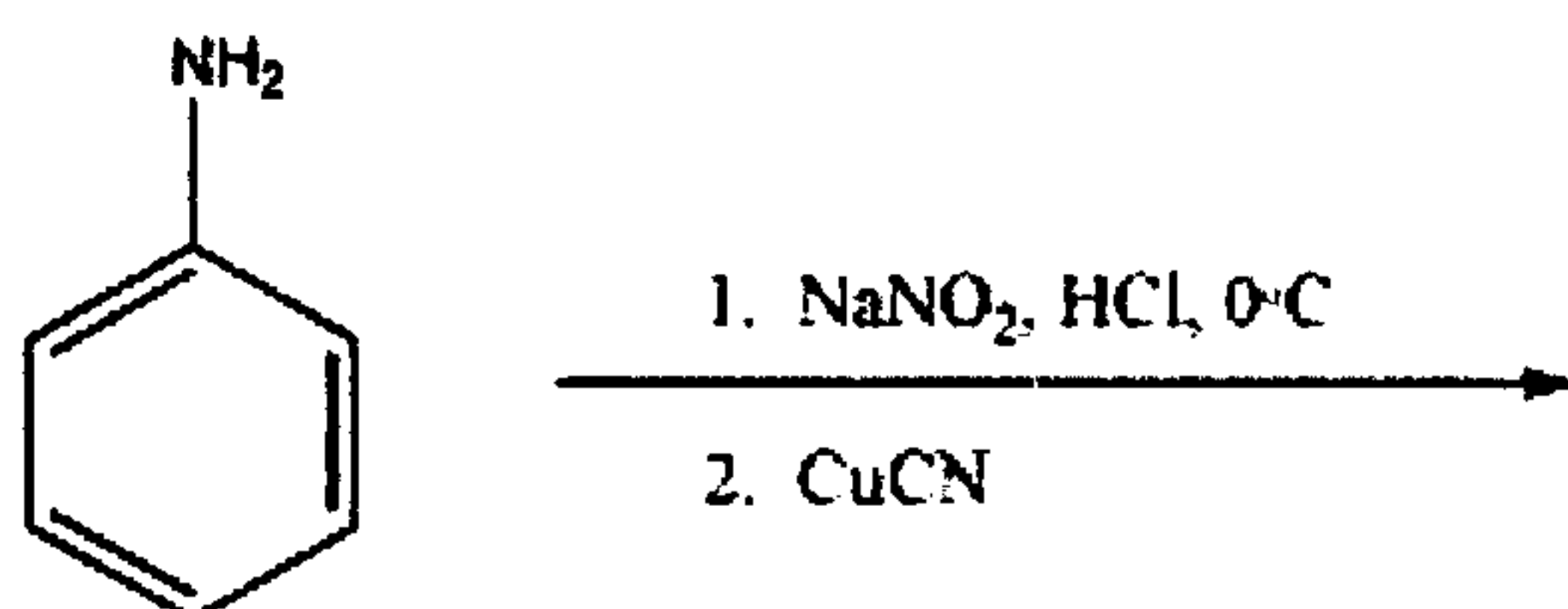
共 15 頁第7頁

11) Which of the following reactions can be used to prepare



- A) I
- B) II
- C) III
- D) B and C
- E) A, B and C

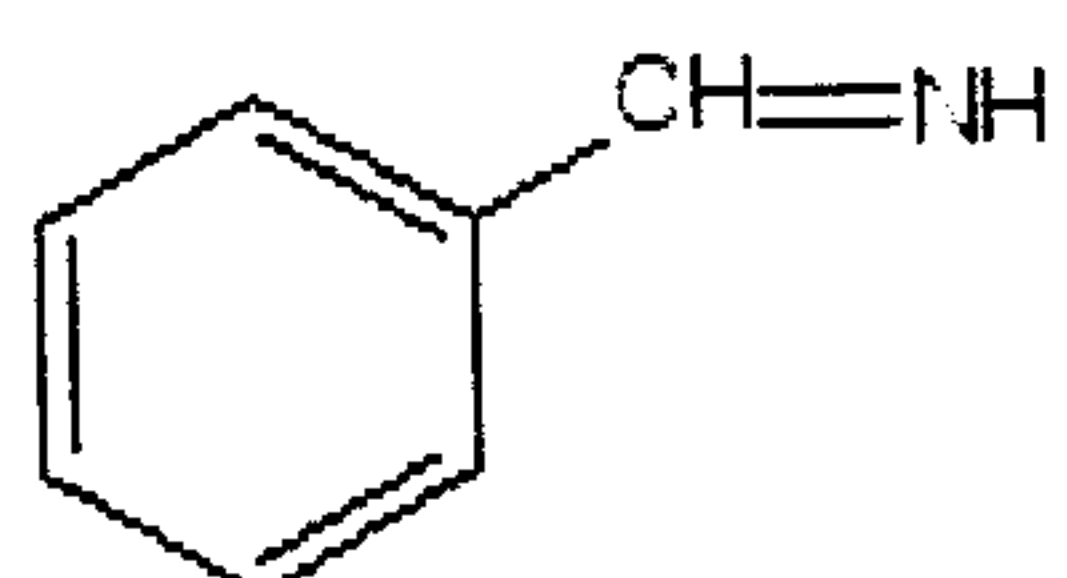
12) Identify the best product for the reaction.



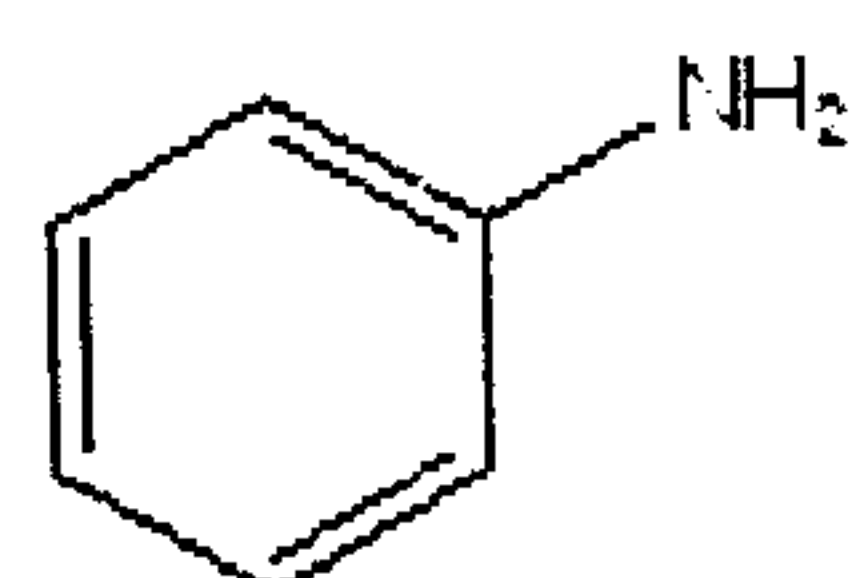
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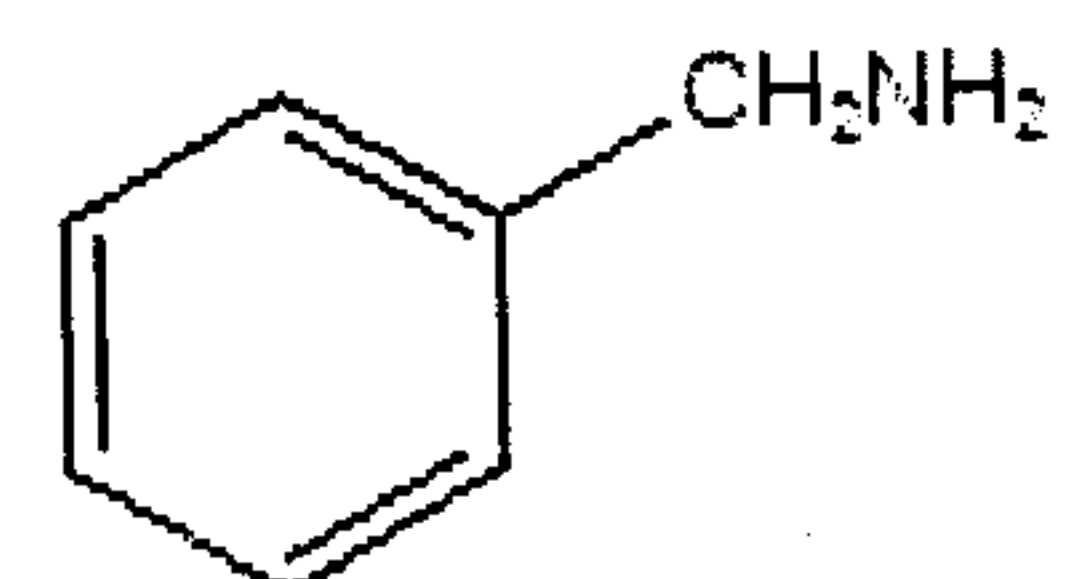
A)



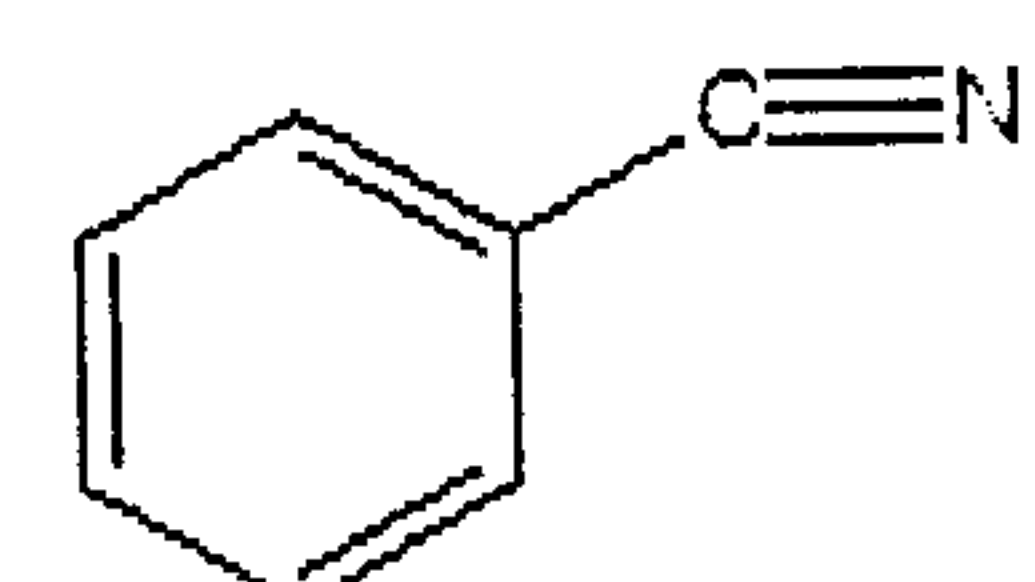
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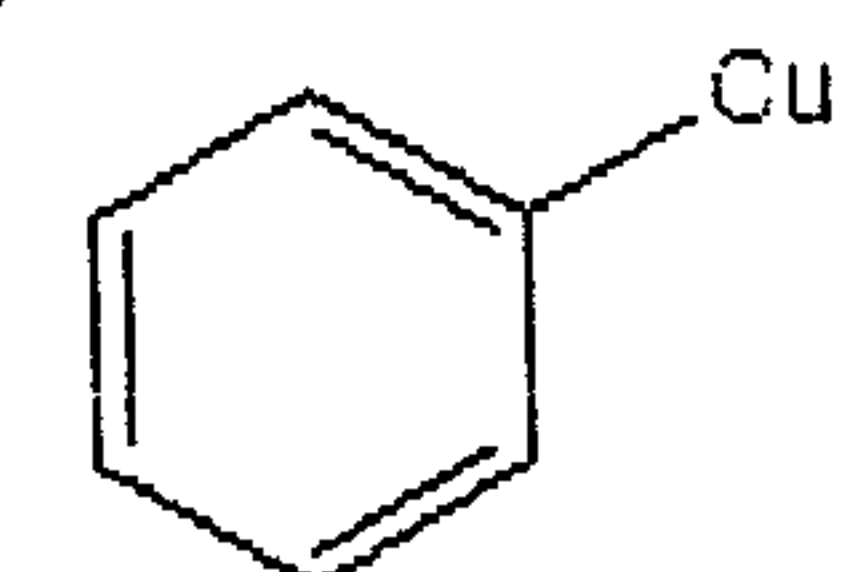
C)



D)



E)



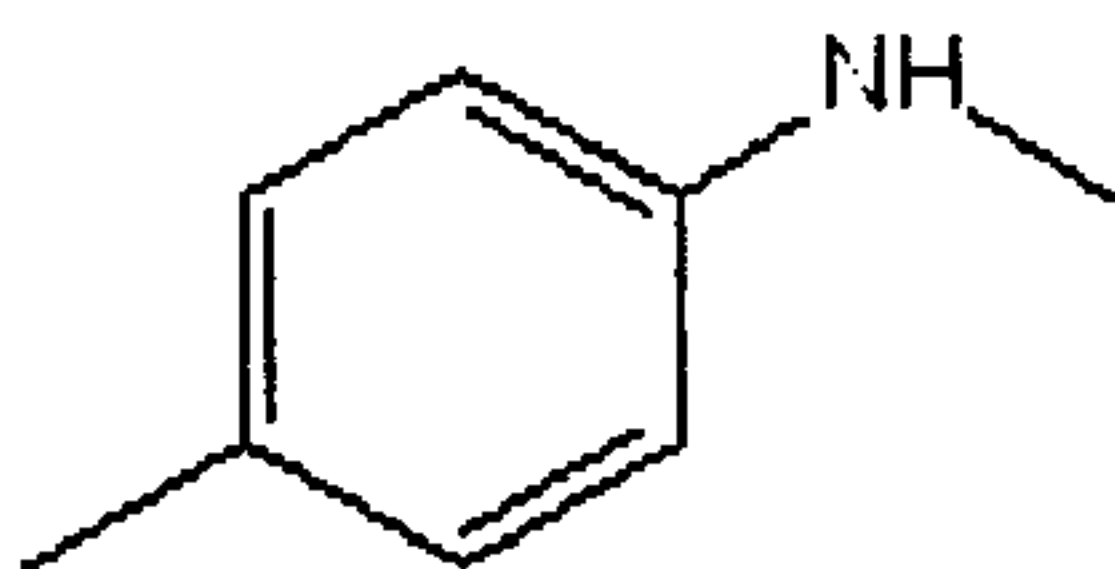


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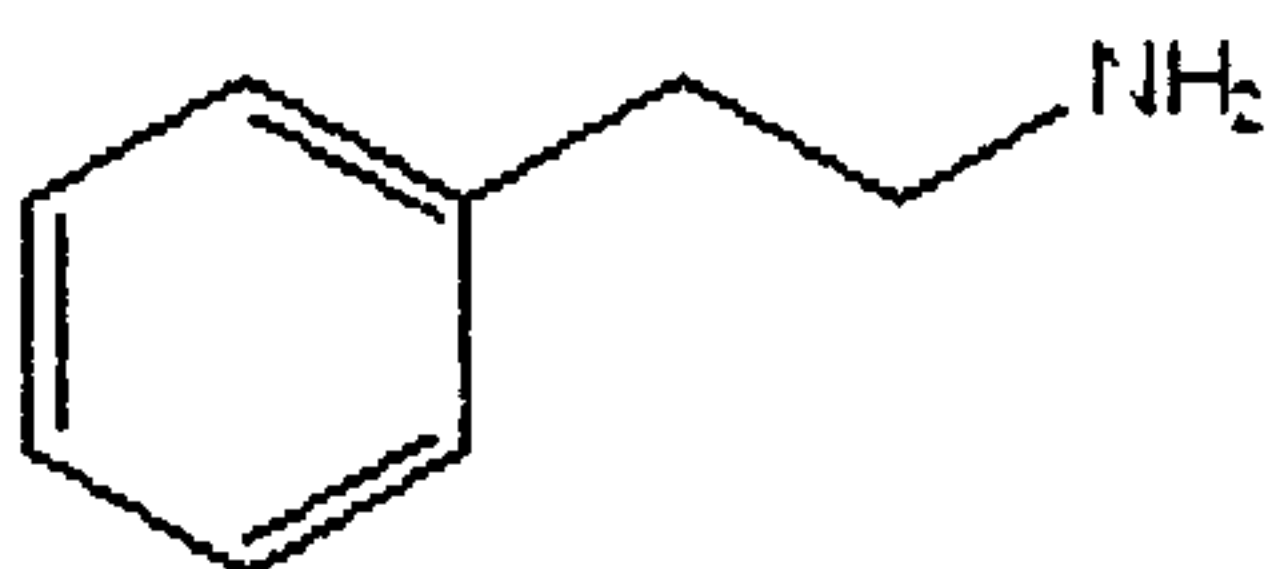
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13) Give the structure of a compound that has a formula of  $C_8H_{11}N$  and has signals in the  $^{13}C$  NMR spectrum at 25.9 ppm ( $CH_3$ ), 51.1 ppm ( $CH$ ), 125.9 ppm ( $CH$ ), 126.6 ppm ( $CH$ ), 128.3 ppm ( $CH$ ), and 148.5 ppm (C).

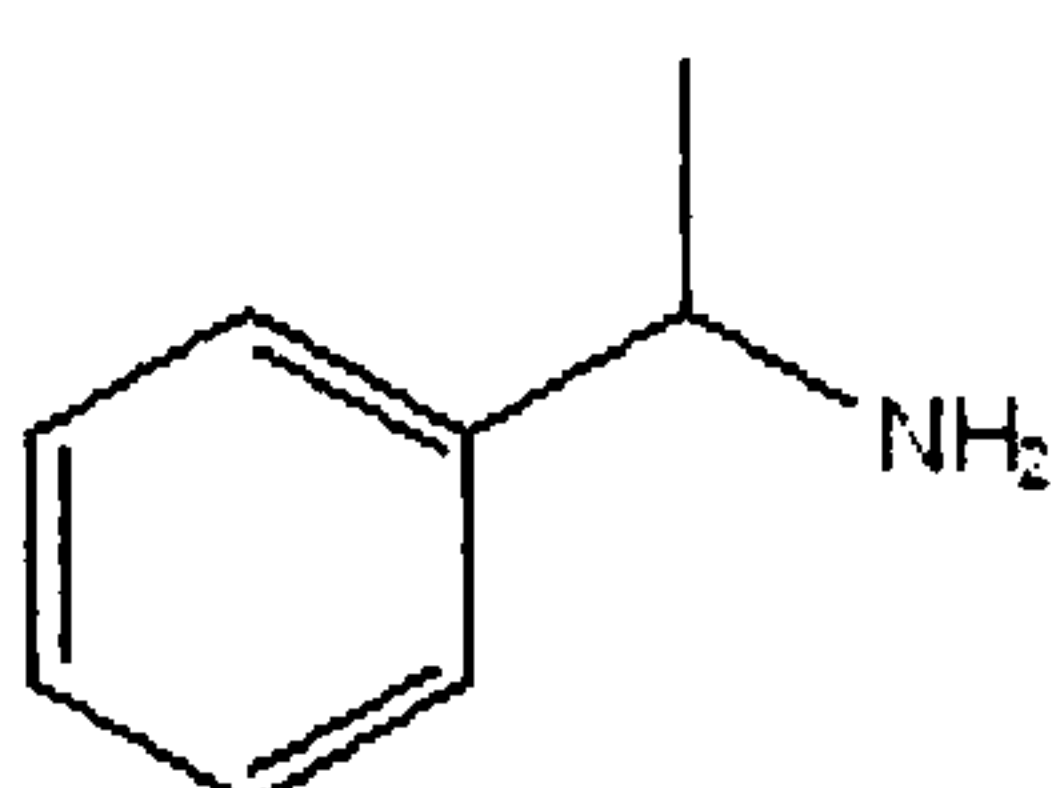
A)



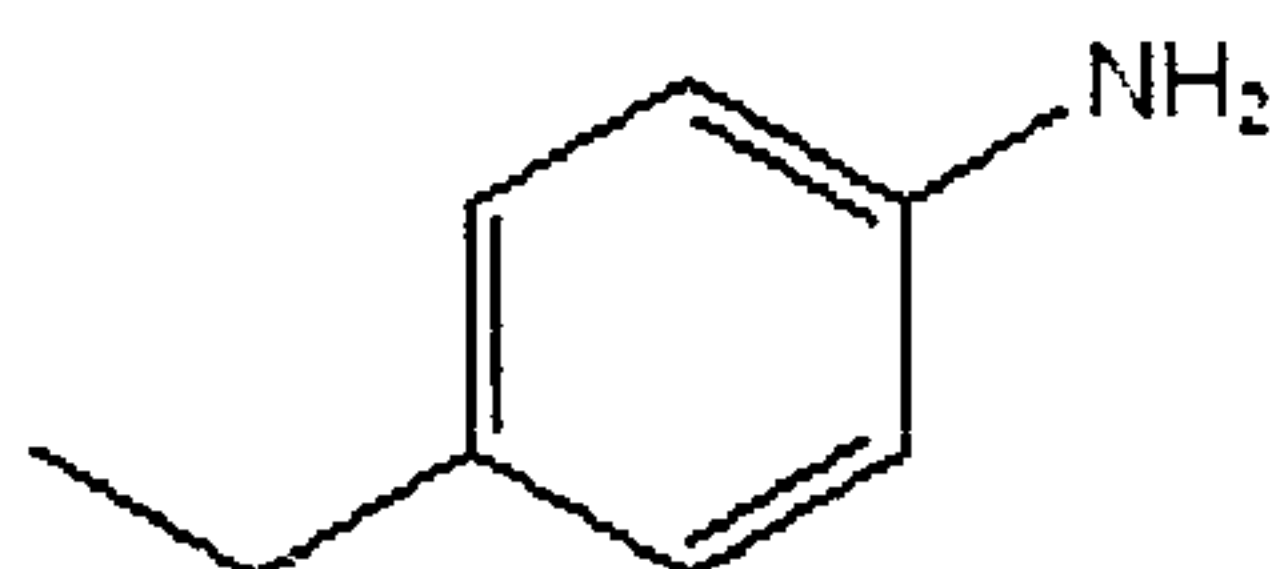
B)



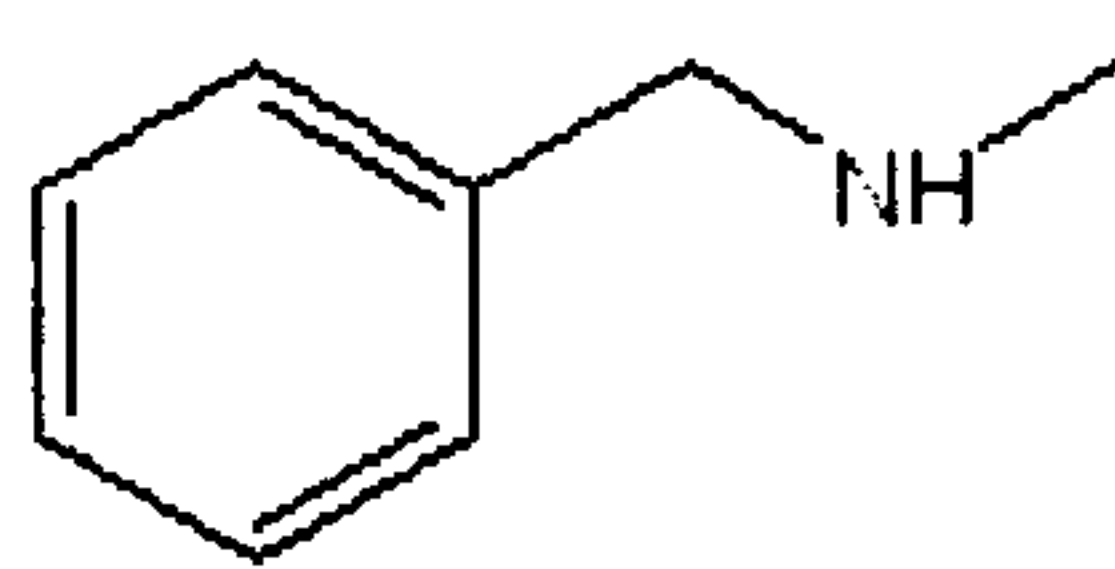
C)



D)



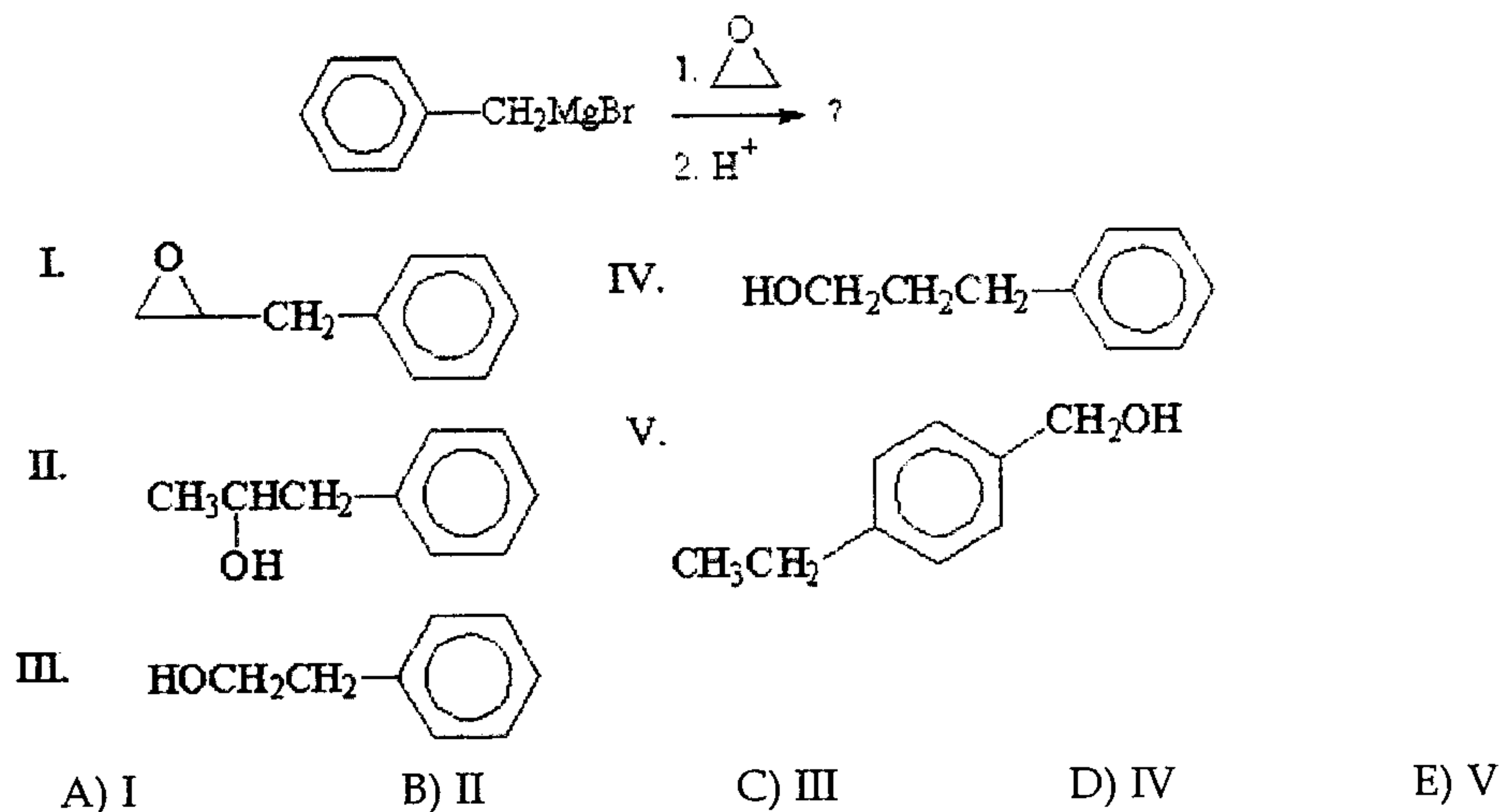
E)



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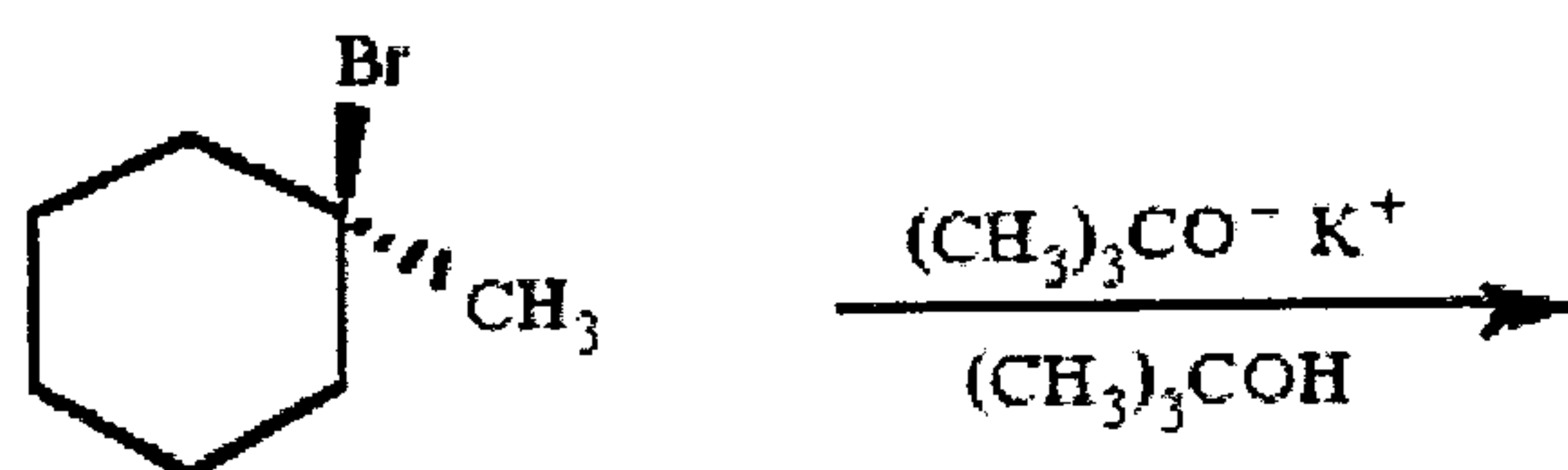
14) What is the product of the following reaction?



- 15) An increase in conjugation is correlated with \_\_\_\_\_ in the energy of the LUMO, \_\_\_\_\_ in the energy of the HOMO, and \_\_\_\_\_ in  $I_{max}$ .
- A) a decrease, an increase, an increase  
 B) an increase, a decrease, a decrease  
 C) an increase, an increase, a decrease  
 D) a decrease, an increase, a decrease  
 E) an increase, a decrease, an increase

第二部分非選擇題 (No. 16-25) 請在答案卷作答  
 每題2分共20分

- 16) Draw all likely alkene products in the following reaction and circle the product you expect to predominate.



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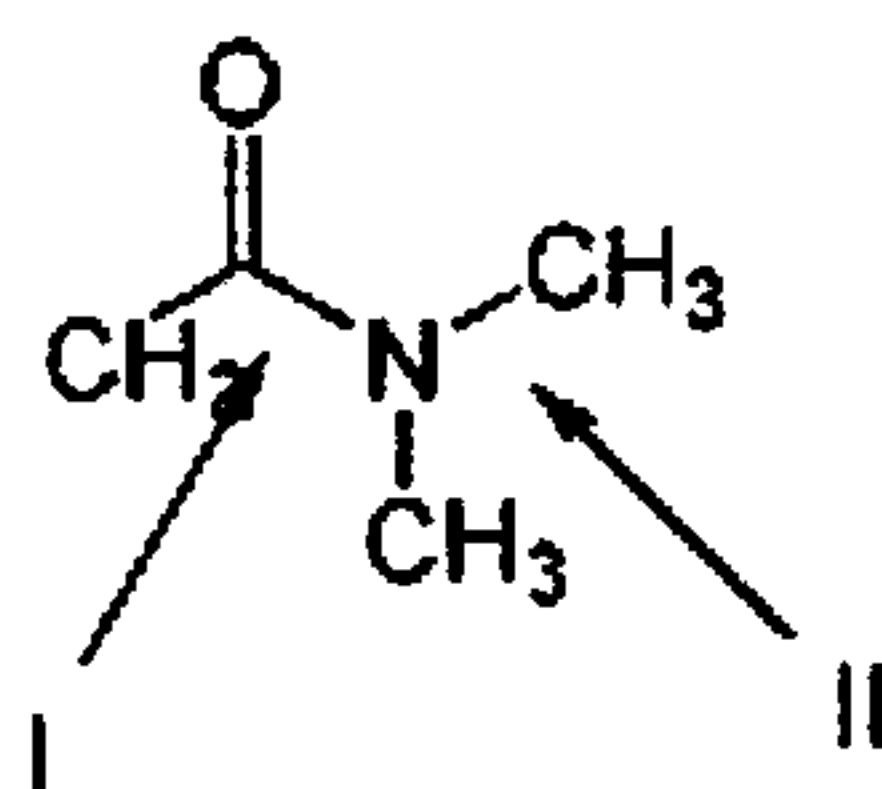
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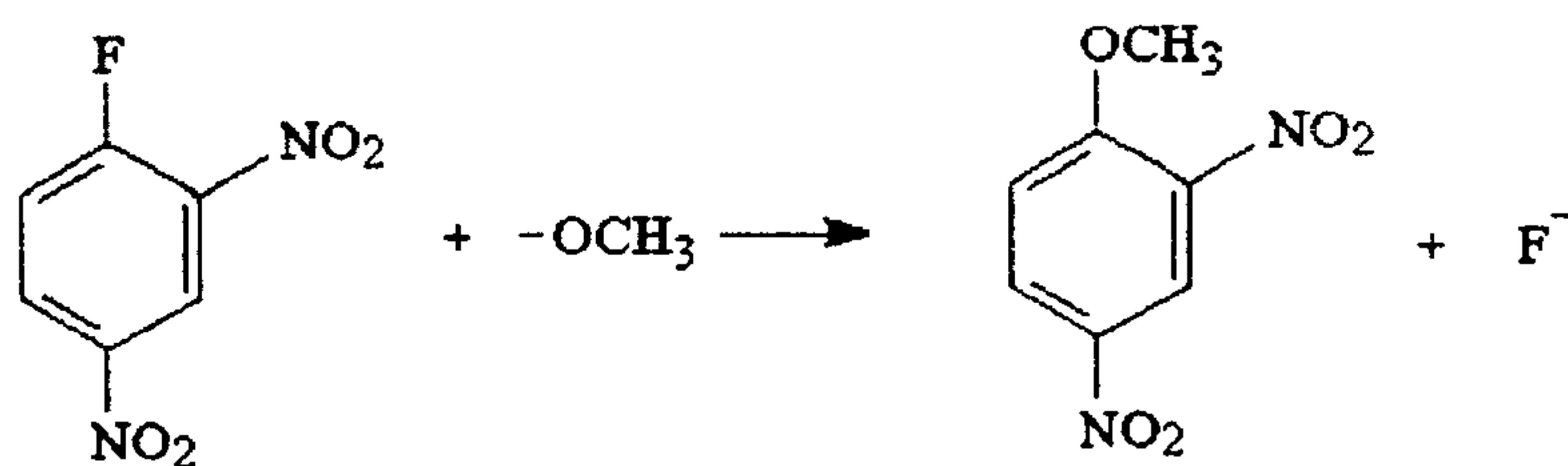
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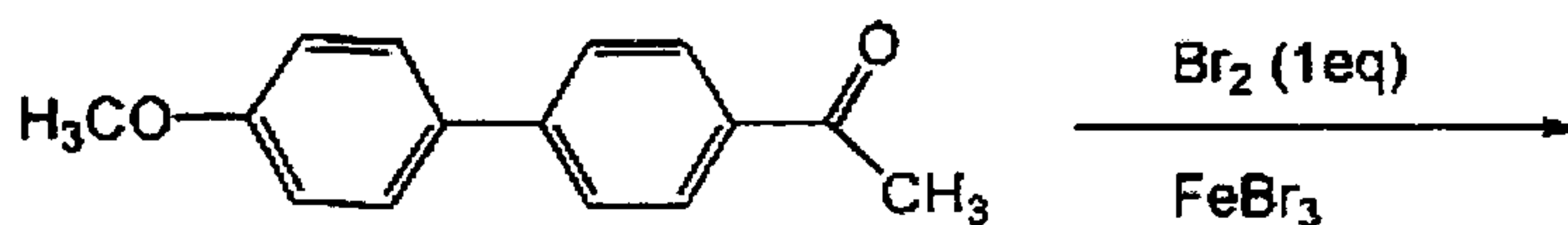
17) Which C-N bond below is shorter, I or II? Explain.



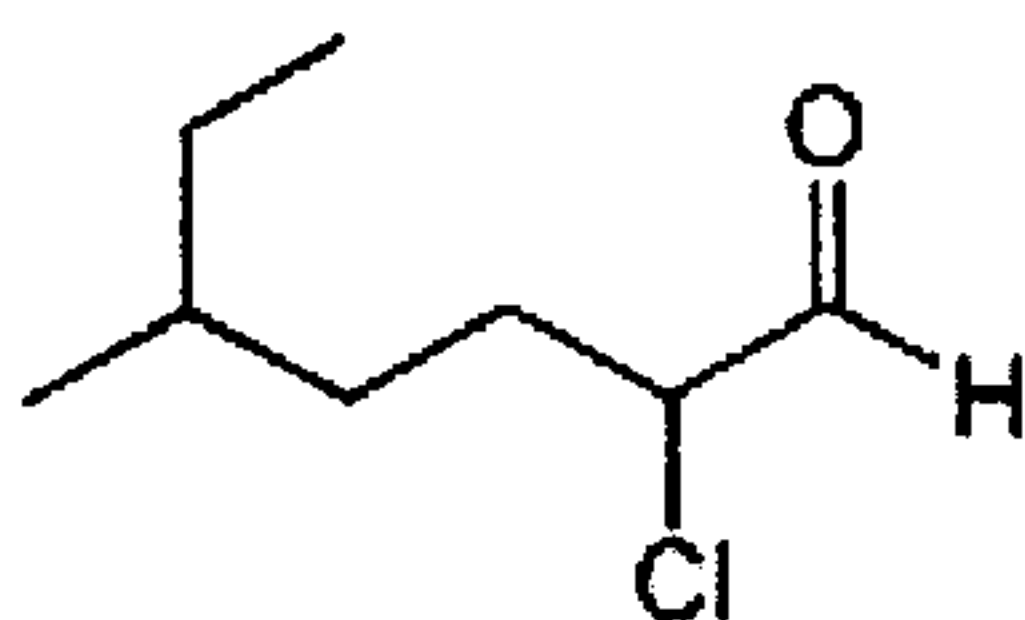
18) Provide a detailed, stepwise mechanism for the following reaction.



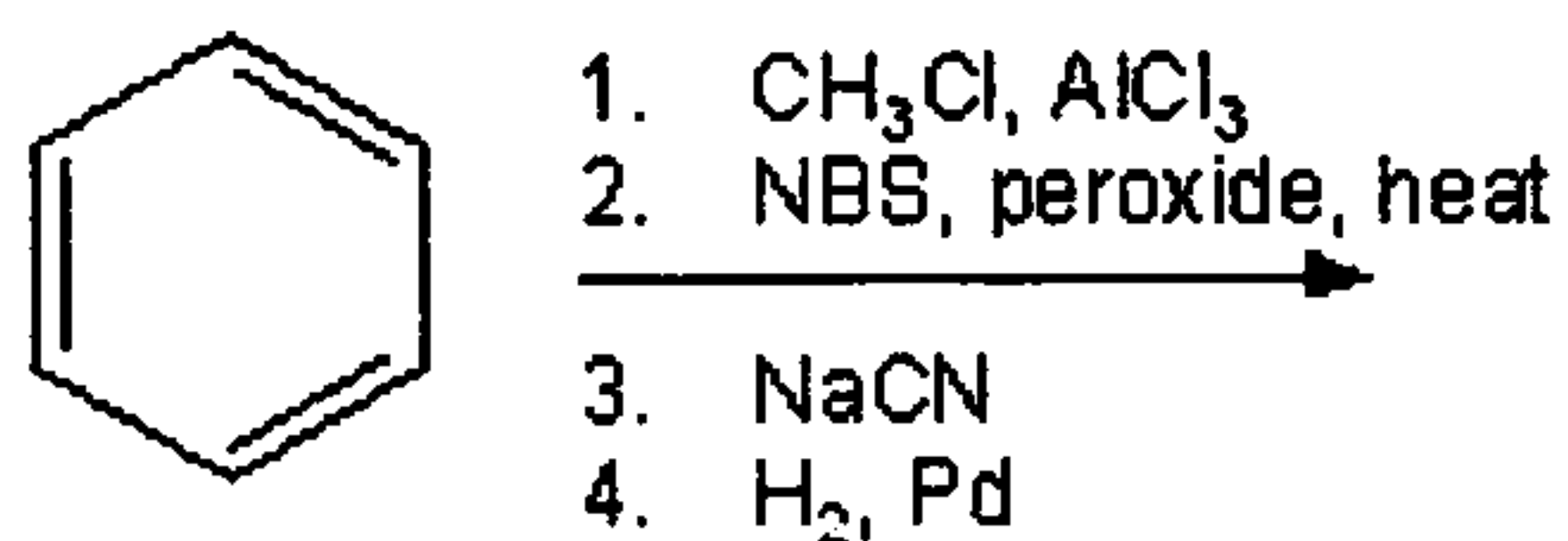
19) Provide the major organic product(s) of the reaction below.



20) Provide the systematic name of the compound below.



21) Give the best product for the following reaction.

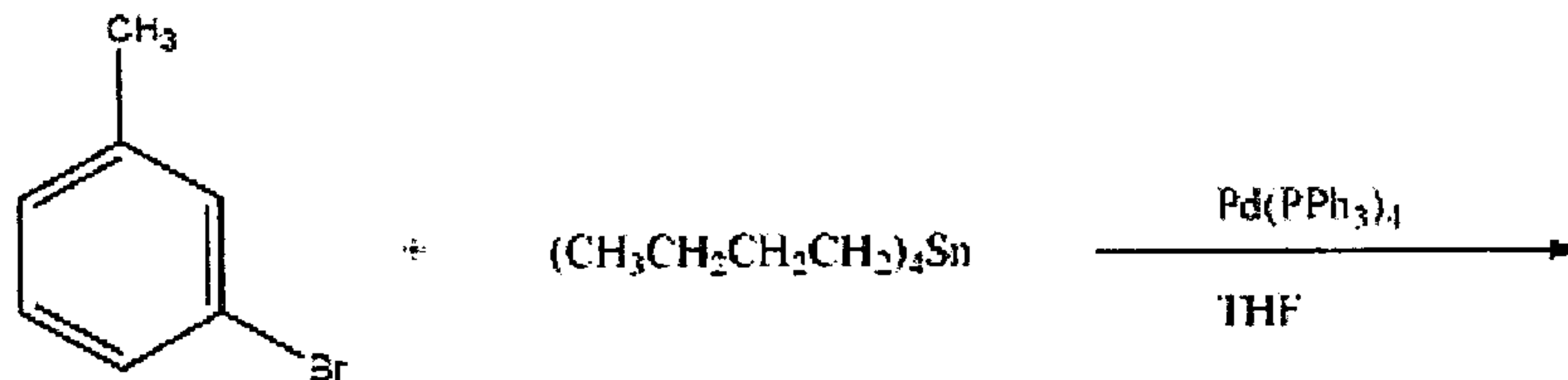


22) Draw the three major resonance structures of the carbocation intermediate in the reaction of acetophenone with HNO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> to yield *o*-nitroacetophenone. Circle the resonance form which is less stable than the other two.

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23) Provide the major organic product of the reaction below.



24) An unknown compound,  $\text{C}_3\text{H}_5\text{Cl}_3$ , gave the following proton NMR data:

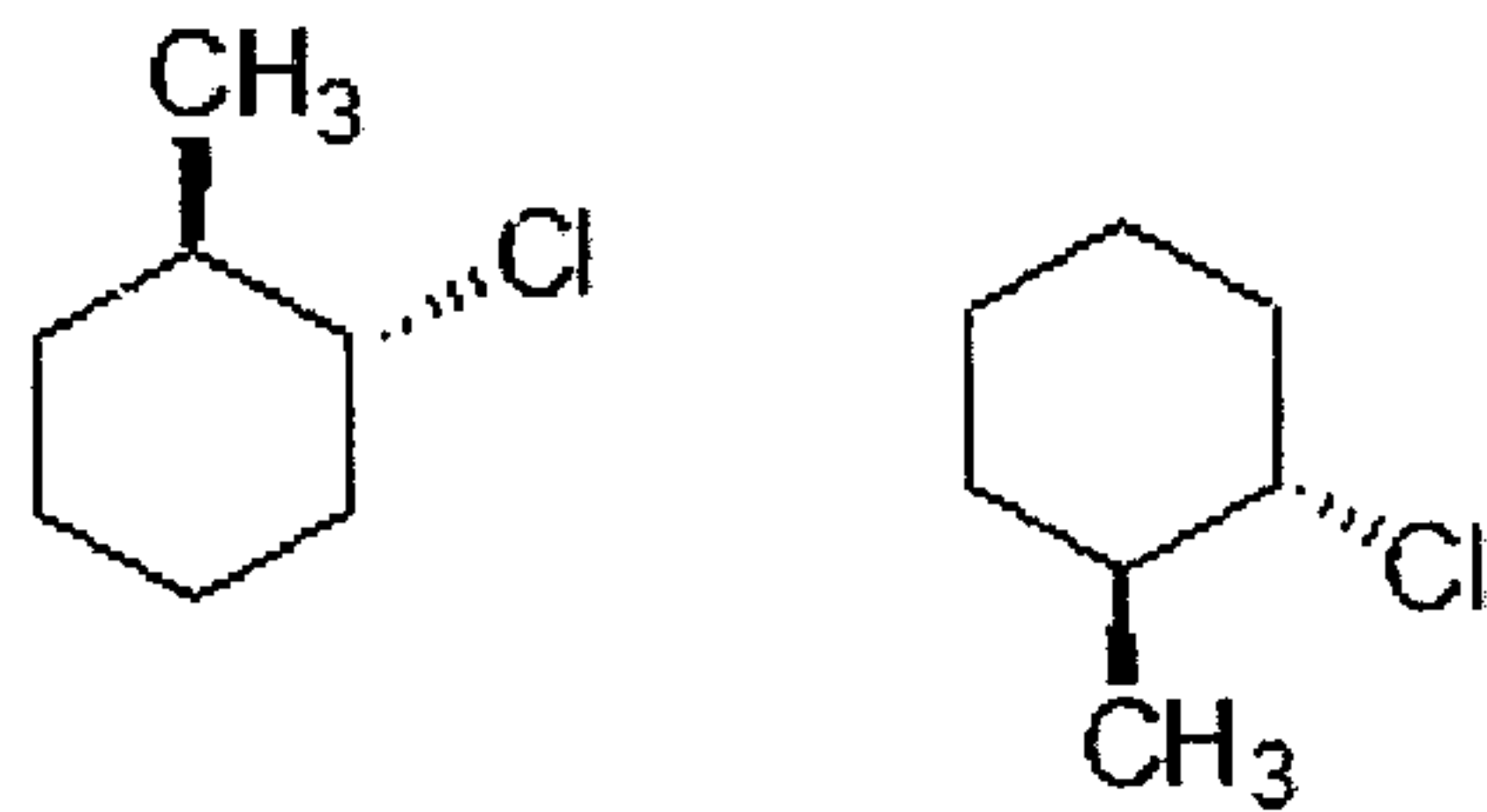
Doublet at 1.70 ppm (3H)

Multiplet at 4.32 ppm (1H)

Doublet at 5.85 ppm (1H)

What is the structure of the compound?

25) Which of the following terms best describes the pair of compounds shown:  
enantiomers, diastereomers, or the same compound?



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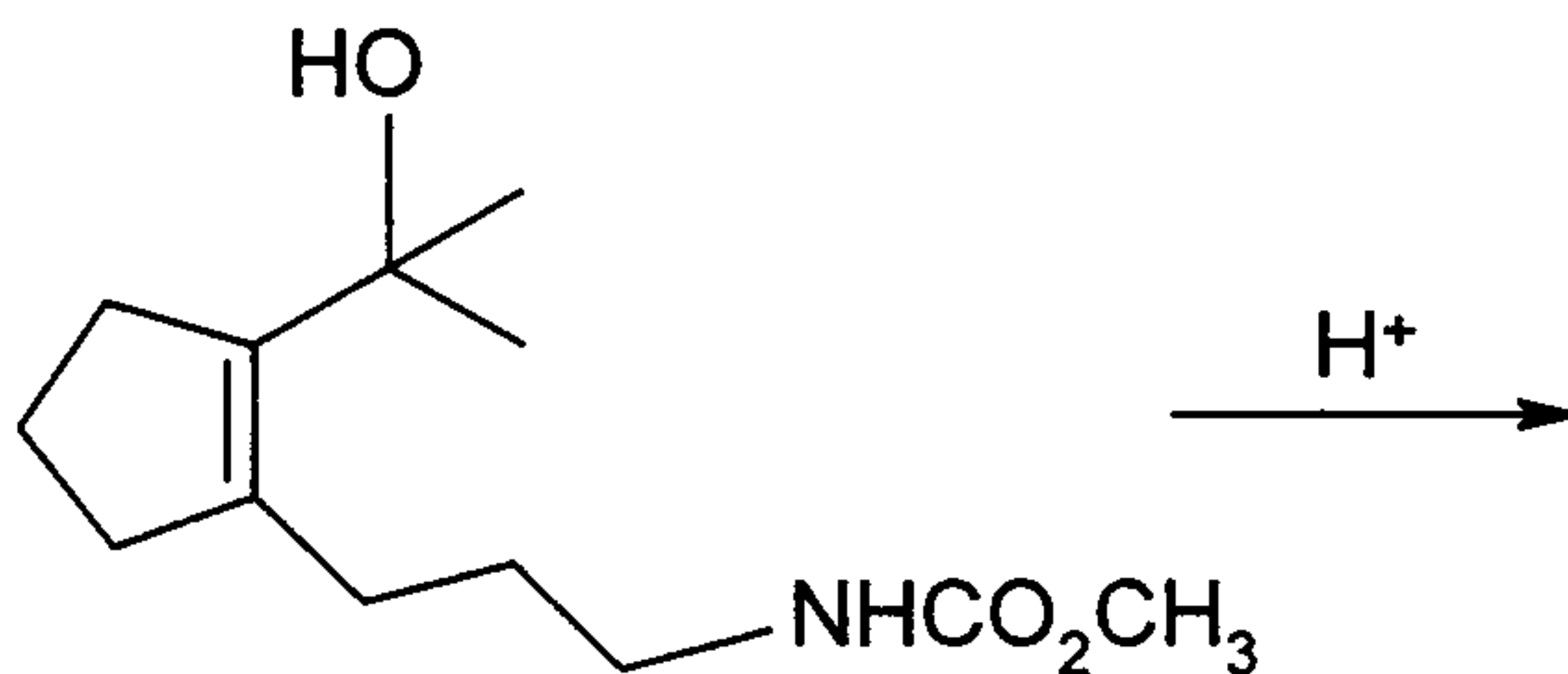
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第三部分 問答題 (No. 26-30) 請在答案卷作答

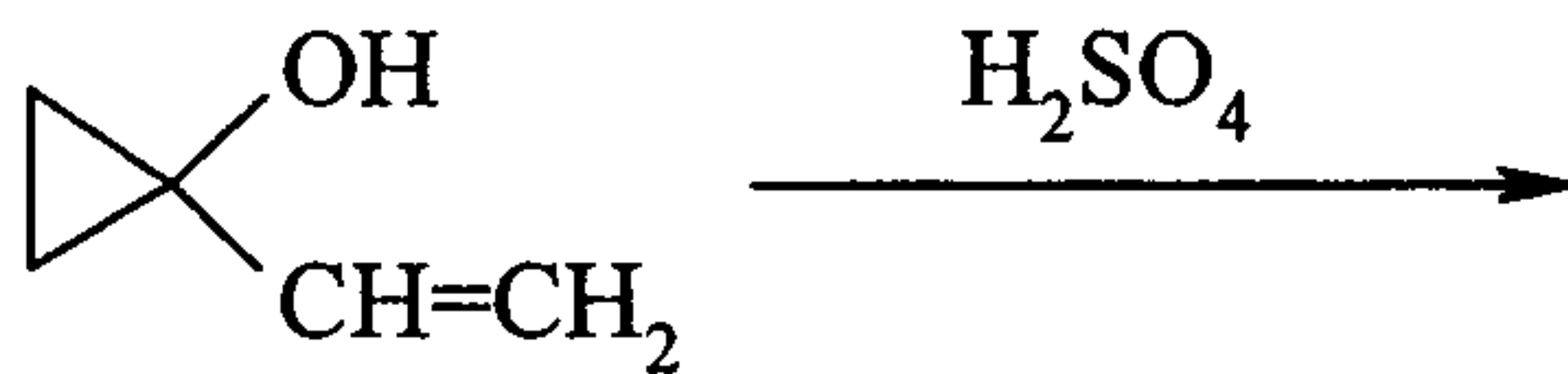
共 50 分

26) Please provide the structure of the major product for each of the following reactions, and include stereochemistry where appropriate (24 分, 每小題 3 分).

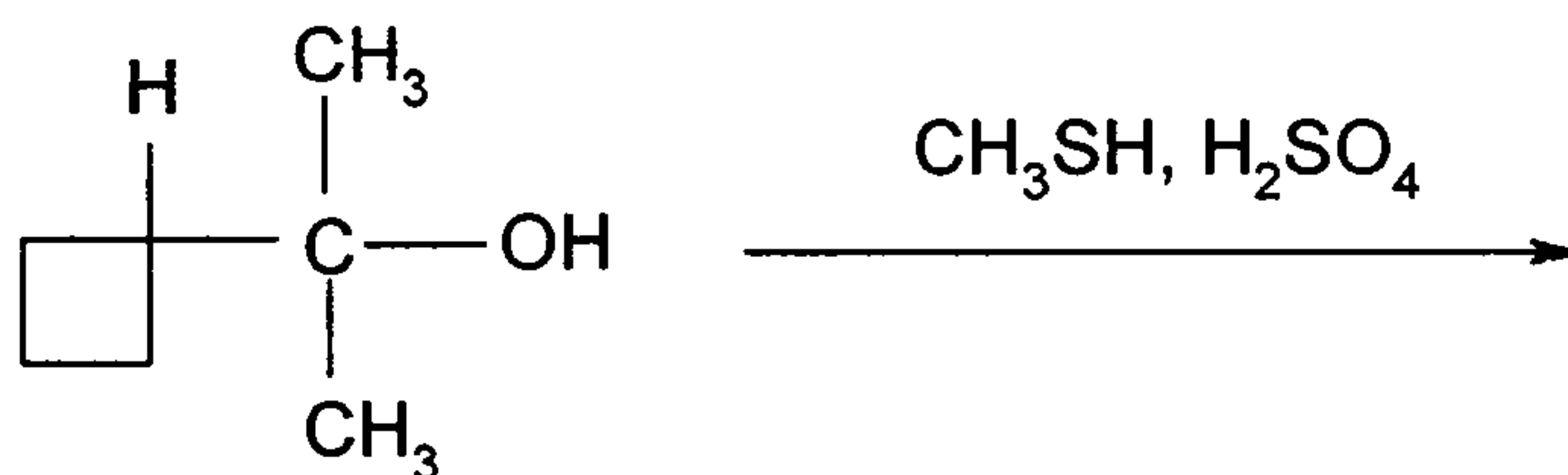
(a)



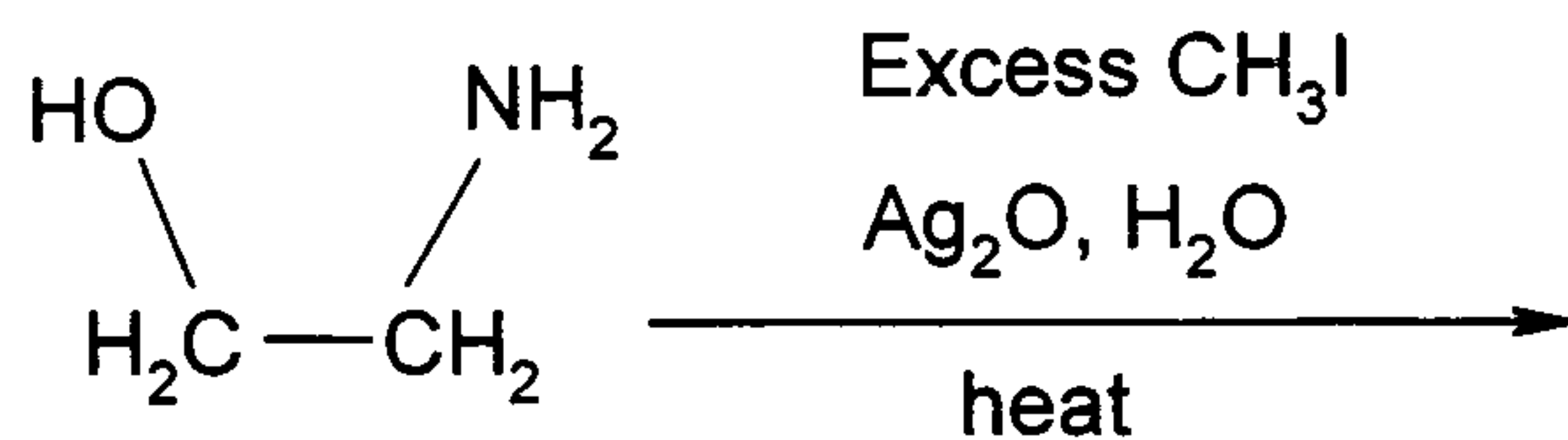
(b)



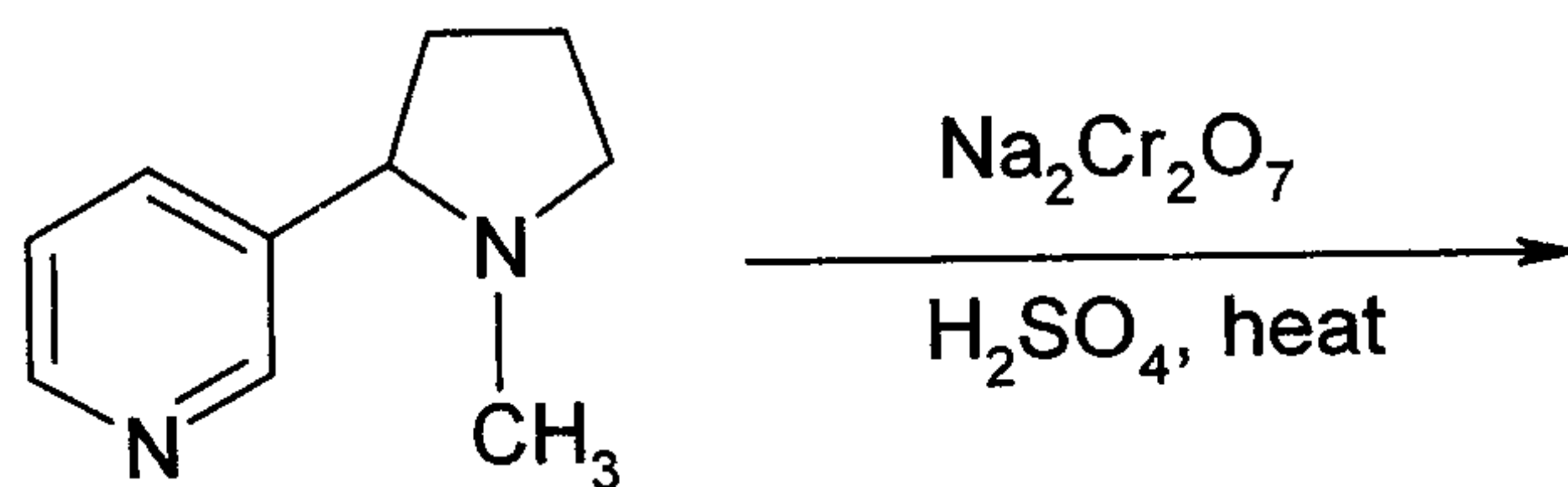
(c)



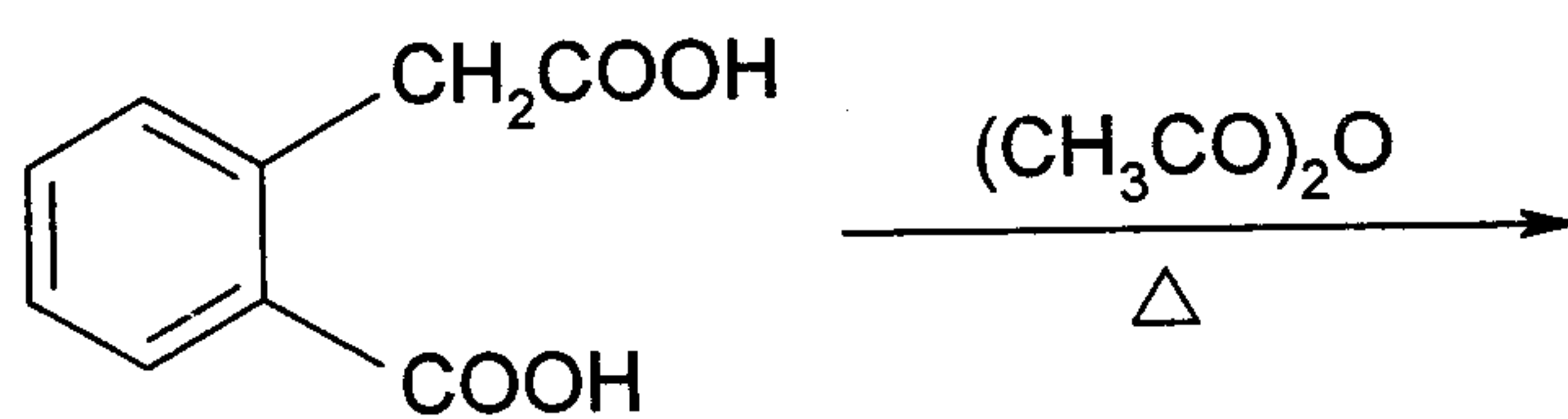
(d)



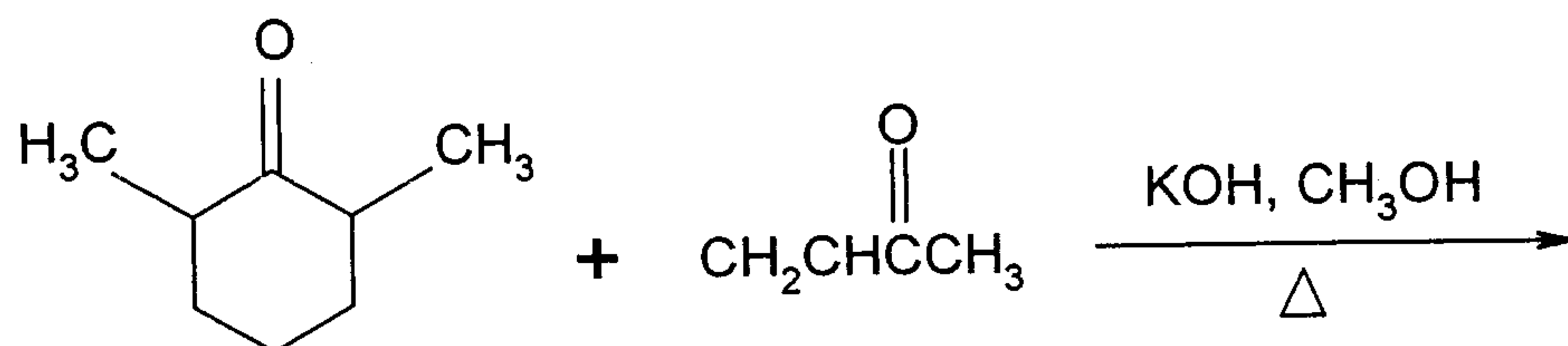
(e)



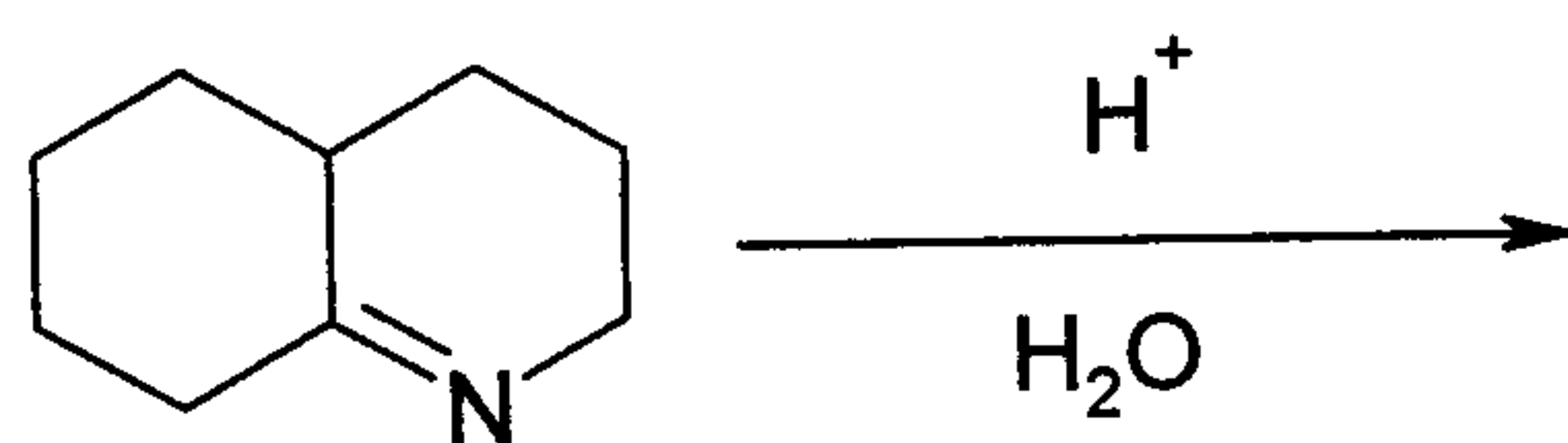
(f)



(g)



(h)

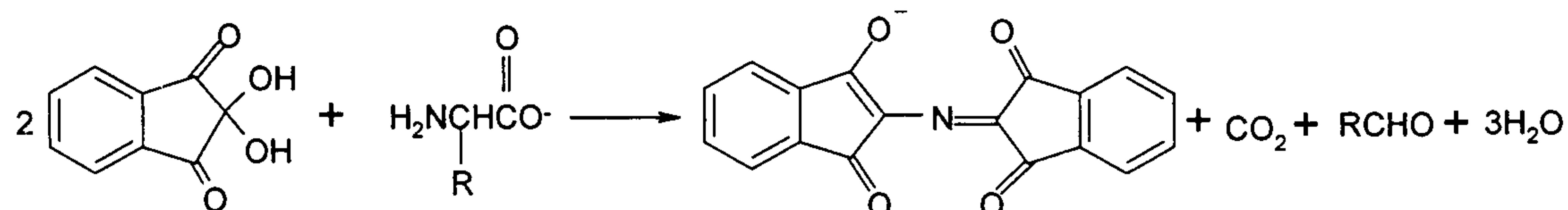


國立清華大學101學年度碩士班入學考試命題紙  
 生醫工程與環境科學系(0522)  
 甲組 (分子生醫光電組)

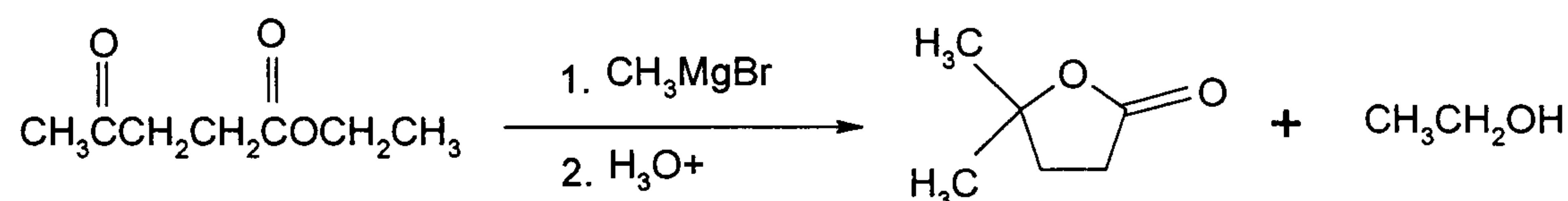
科目有機化學 科目代碼 2204  
 共 15 頁第 15 頁

27) Please propose a step-by-step reaction mechanism for the following reactions (14 分)

(a)



(b)



28) Three isomeric ketones with the molecular formula C<sub>7</sub>H<sub>14</sub>O are converted into heptanes by Clemmensen reduction. Compound A gives a single product on Baeyer-Villiger oxidation; Compound B gives two different products in very different yields; Compound C gives two different products in virtually a 1:1 ratio. Please identify A, B and C. (4 分)

29) *cis*-1-Bromo-2-*tert*-butylcyclohexane and *trans*-1-bromo-2-*tert*-butylcyclohexane both react with sodium ethoxide in ethanol to give 1-*tert*-butylcyclohexane. The *cis* isomer reacts much more rapidly than the *trans* isomer. Please explain this observation. (4 分)

30) Phosgene (COCl<sub>2</sub>) is known as a poison gas. Please give product that would be formed from the reaction of phosgene with the following reagents:

1. one equivalent of methanol. (1 分)
2. excess methanol (1 分)
3. one equivalent of ethanol followed by one equivalent of methylamine. (2 分)