

國立清華大學命題紙

97 學年度 生醫工程與環境科學 (所系 (所) 甲組碩士班入學考試

科目有機化學 科目代碼 2504 共 8 頁第 1 頁 \*請在【答案卷】內作答

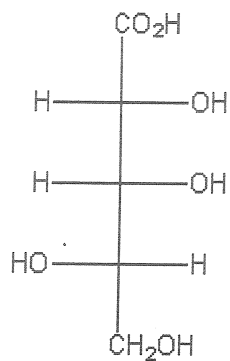
第一部分 選擇題 (No. 1-13) 請在答案卷作答  
單選 每題2分 共26分

1) What is the relationship between the following compounds?



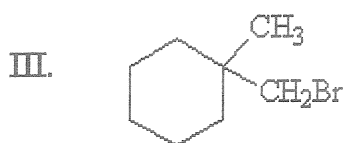
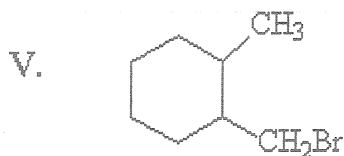
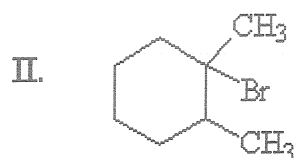
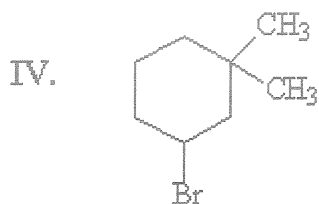
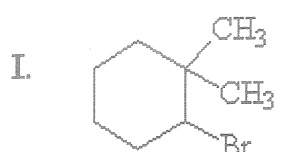
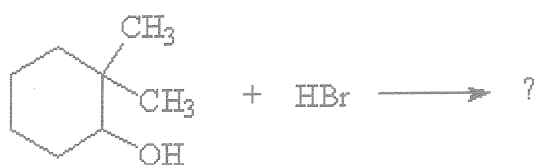
- A) diastereomers
- B) enantiomers
- C) constitutional isomers
- D) superimposable without bond rotation
- E) conformational isomers

2) How many diastereomers exist for the compound below?



- A) 4
- B) 2
- C) 7
- D) 6
- E) 8

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



A) I

B) II

C) III

D) IV

E) V

4) Which of the following bromides reacts readily via an  $S_N2$  reaction with  $\text{NaN}_3$ ?

A) 1-bromo-1-methylcyclohexane

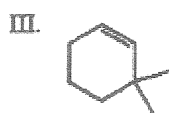
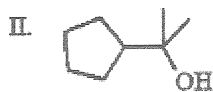
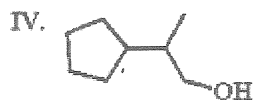
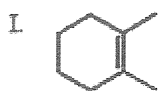
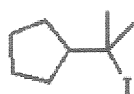
B)  $\text{C}_6\text{H}_5\text{Br}$

C)  $(\text{C}_6\text{H}_5)_3\text{CBr}$

D)  $(\text{CH}_3)_3\text{CCH}_2\text{CH}_2\text{CH}_2\text{Br}$

E)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CHBr}$

5) Which of the following is least likely to be found in the product mixture which results when the alkyl iodide below is heated in water?



A) I

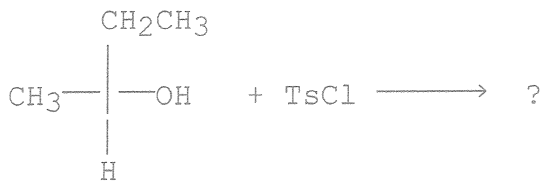
B) II

C) III

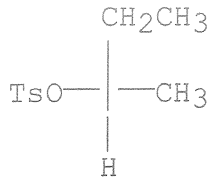
D) IV

E) V

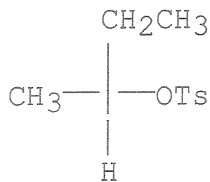
6) What is the product of the following reaction?



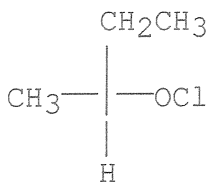
A)



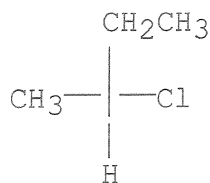
B)



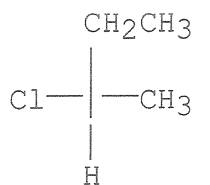
C)



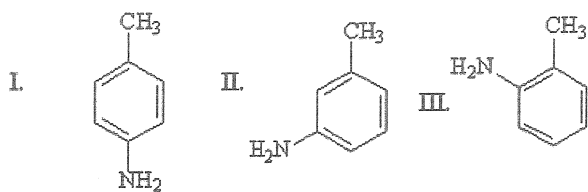
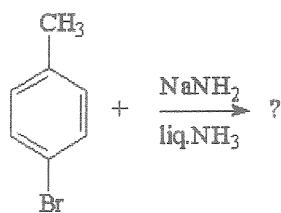
D)



E)



7) What are the products of the following reaction?



A) I

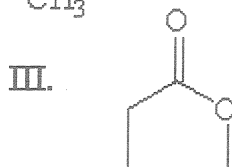
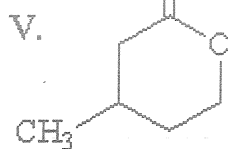
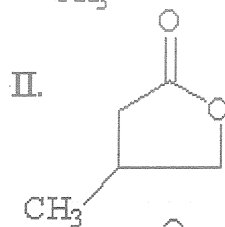
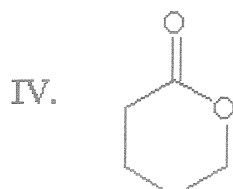
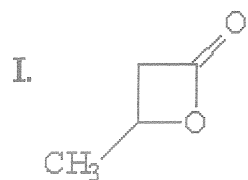
B) II

C) III

D) A and B

E) B and C

8) Which of the following compounds is  $\lambda$ -butyrolactone?



A) I

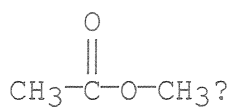
B) II

C) III

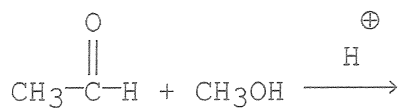
D) IV

E) V

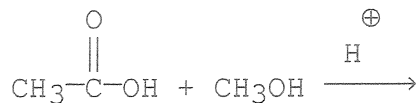
9) Which of the following is the best method for preparing



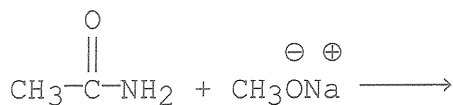
A)



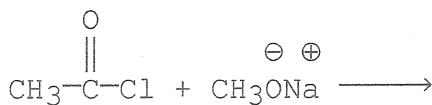
B)



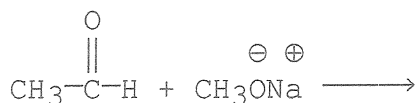
C)



D)



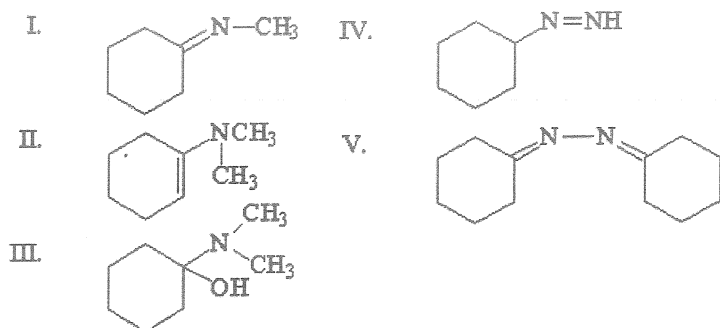
E)



10) Predict the major organic product of the reaction between N-methylbenzamide and sodium propanoate.

- A) N-propylbenzamide
- B) benzoic propanoic anhydride
- C) propyl benzoate
- D) phenyl propanoate
- E) no reaction

11) Which of the following is an enamine?

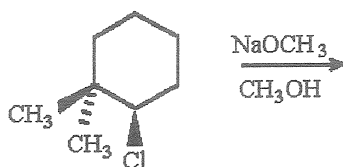


- A) I                      B) II                      C) III                      D) IV                      E) V

12) Which of the compounds below undergoes solvolysis in aqueous ethanol most rapidly?

- A) isopropyl chloride
- B) cyclohexyl bromide
- C) 3-chloropentane
- D) 3-iodo-3-methylpentane
- E) methyl iodide

13) Predict the most likely mechanism for the reaction shown below.



- A) E1                      B) S<sub>N</sub>1                      C) S<sub>N</sub>2                      D) E2                      E) E1cb

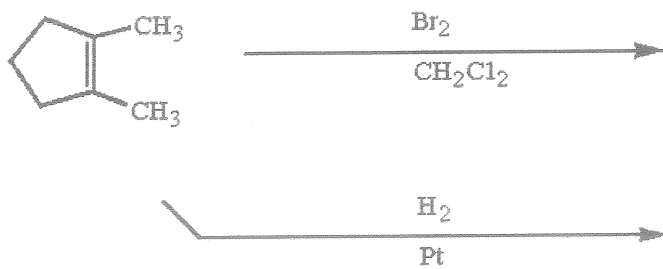
第二部分 非選擇題 (No. 14-32) 請在答案卷作答  
共74分

14) What kind of molecular orbital ( $\sigma$ ,  $\sigma^*$ ,  $\pi$ , or  $\pi^*$ ) results when the two atomic orbitals shown below interact in the manner indicated? 2 pts

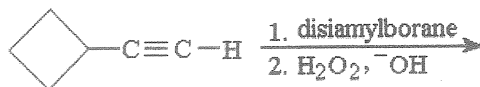


15) Consider the one-step conversion of F to G. Given that the reaction is endergonic by 5 kcal/mol and that the energy difference between G and the transition state for the process is 15 kcal/mol, sketch a reaction-energy profile for this reaction. Make sure to show how the given energy differences are consistent with your sketch.  
3 pts

16) Provide the structure of the major organic product of each of the following reactions. 2 pts for each



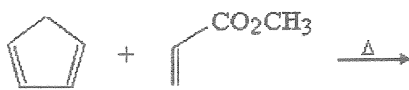
17) Provide the structure of the major organic product(s) in the reaction below. 3 pts



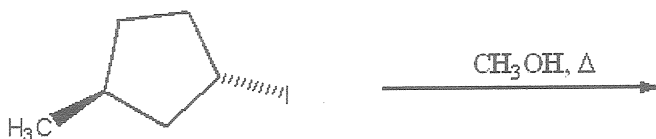
18) Starting with acetylene, how could the following compounds be synthesized? 5 pts for qust. a.; 4 pts for qust. b.



19) Provide the structure of the major organic product in the following reaction. 3 pts



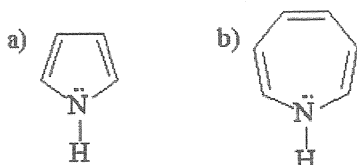
20) Provide the structure of the major organic product(s) of the following reaction. 3 pts



21) Provide the structure of the major organic product of the following reaction. Explain the stereochemistry which results in this product. 3 pts



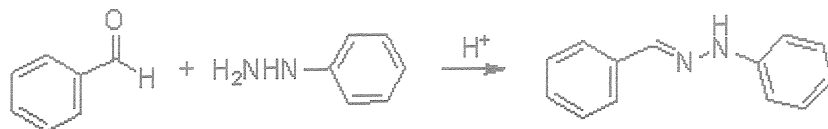
22) One of the following compounds is aromatic and the other is antiaromatic. Which is which? 3pts



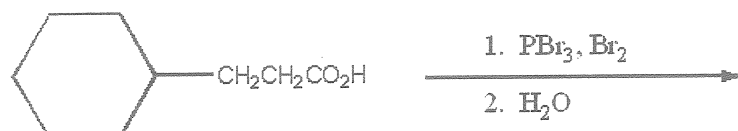
23) Provide the major organic product of the following. 3 pts



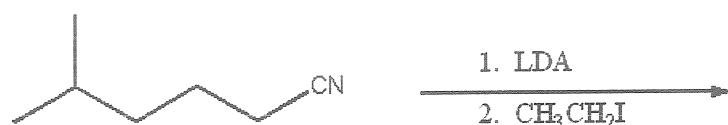
24) Propose a plausible mechanism that would explain the following conversion: 5 pts



25) Provide the major organic product of the following. 3 pts



26) Provide the major organic product of the following. 3 pts



27) Give an explanation using MO theory why back-side attack is favored by  $\text{S}_{\text{N}}2$  mechanism. 6 pts

28) Provide a structure that is consistent with the data below. 5 pts

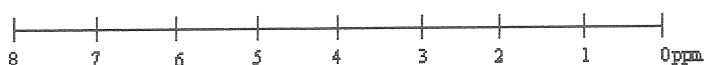
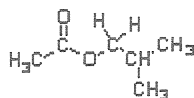


IR ( $\text{cm}^{-1}$ ): 2950, 1740

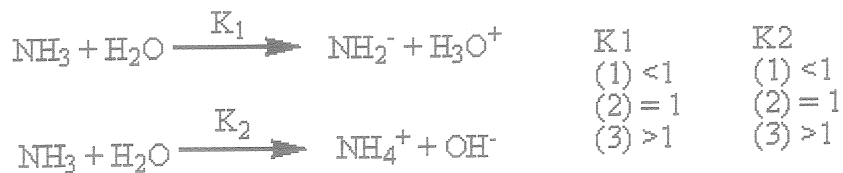
$^1\text{H}$  NMR (d): 2.3 (2H, q), 1.0 (3H, t), 0.9 (9H, s)

$^{13}\text{C}$  NMR (d): 185 (s), 78 (s), 29 (t), 14 (q), 12 (q)

29) Using the scale below, draw the  $^1\text{H}$  NMR spectrum for isobutyl acetate, shown below. Present the peaks with correct splitting patterns and at the approximate chemical shift ( $\pm 0.5$  ppm). Just above each peak, indicate the relative integration value of each type of hydrogen. 5 pts



30) Predict the pKa values for  $\text{NH}_2^-$ ,  $\text{NH}_3$ , and  $\text{NH}_4^+$  and give your choices of the equilibrant constants:  $K_1$  and  $K_2$  from the following reactions. 2 pts for each



31) Consider the possible thermal [4+4] cycloaddition of two molecules of 1,3-butadiene to generate cycloocta-1,5-diene. Show the HOMO/LUMO interaction which would result, and use this interaction to predict whether the proposed cycloaddition could occur. 4 pts

32) Provide the structure of the major organic product in the following reaction. 3 pts

