

國立清華大學 106 學年度碩士班考試入學試題

系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0602、0806)

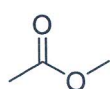
共 9 頁，第 1 頁

*請在【答案卷】作答

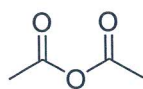
Part 1 簡答題

(70%)

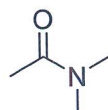
1. Please rank the following acyl derivatives from low to high base on their reactivity as electrophiles toward hydroxide ion. (4%)



A



B



C

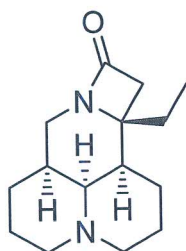


D

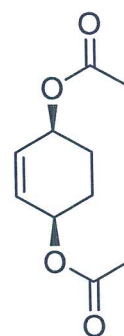
2. Please label each stereocenter with * and its *R* or *S* configuration.

(4% each)

(a)



(b)



3. Please predict the product of the following reaction.

(6%)



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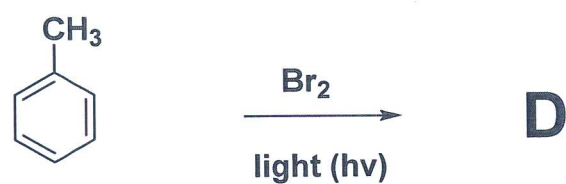
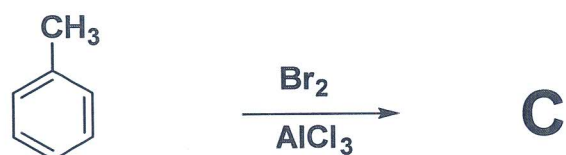
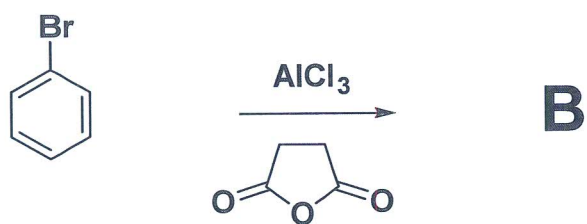
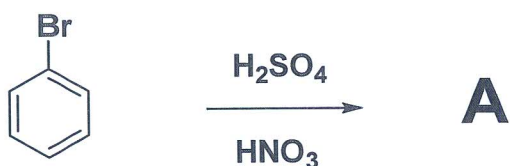
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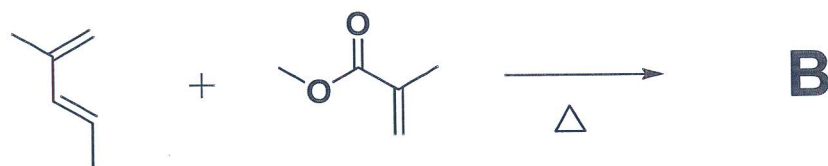
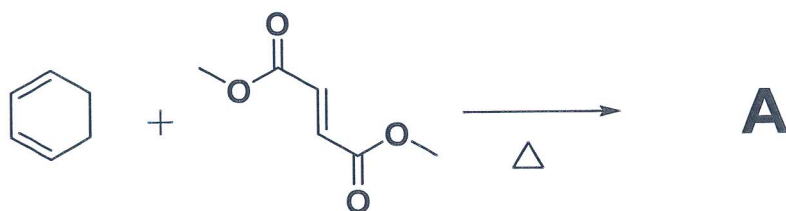
4. Please predict the product of the following reaction.

(3% each)



5. Please draw the structure of the major product of the reaction.

(4% each)



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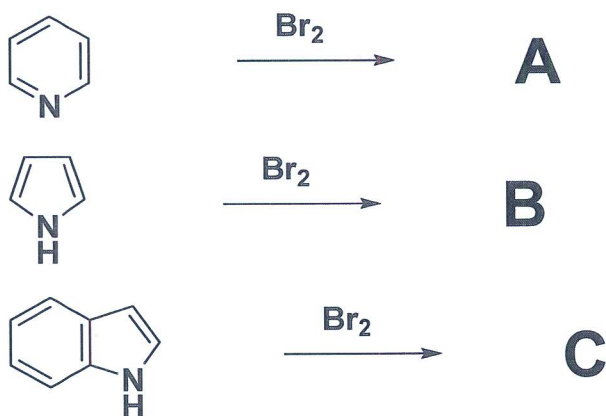
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共 9 頁，第 3 頁

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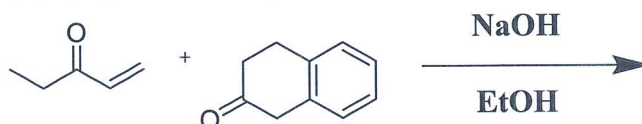
6. Please draw the structure of the major product of each reaction.

(3% each)



7. Please predict the final product and provide detailed reaction mechanism.

(6%)



8. Please propose a mechanism of the following reaction.

(5%)



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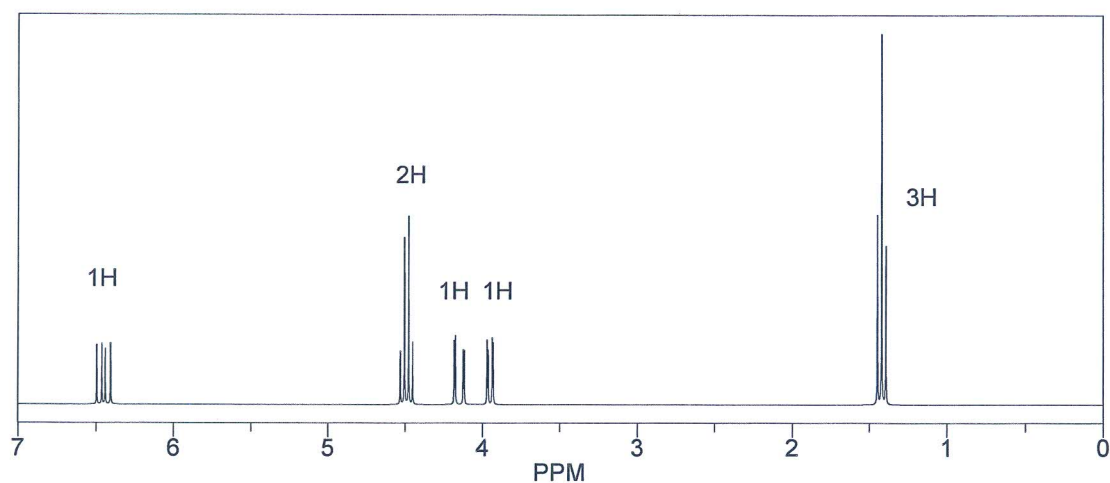
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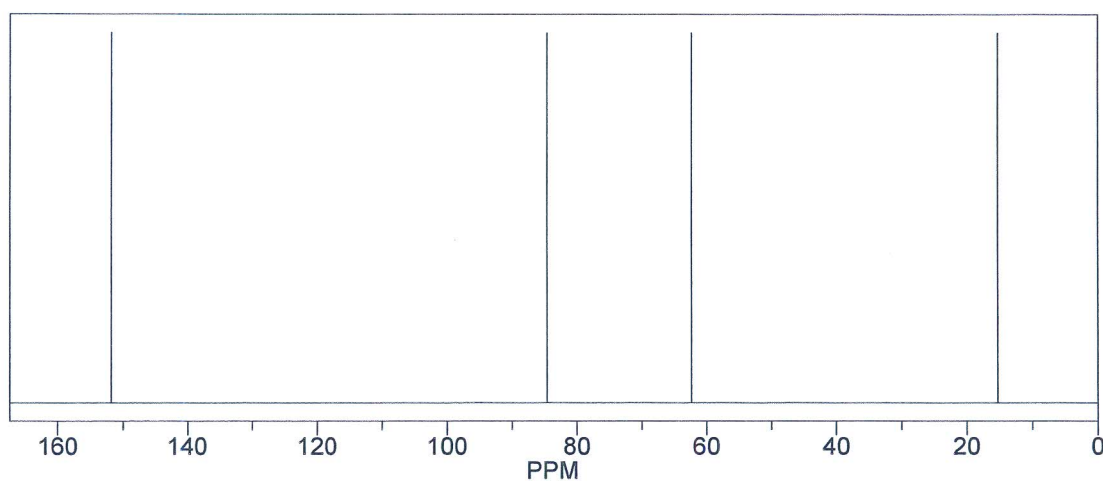
*請在【答案卷】作答

9. The ^1H and ^{13}C NMR spectra of a compound with the molecular formula $\text{C}_4\text{H}_8\text{O}$ are shown below. Use the spectra to propose a structure for this compound with explanation in detail. (6%)

^1H NMR



^{13}C NMR



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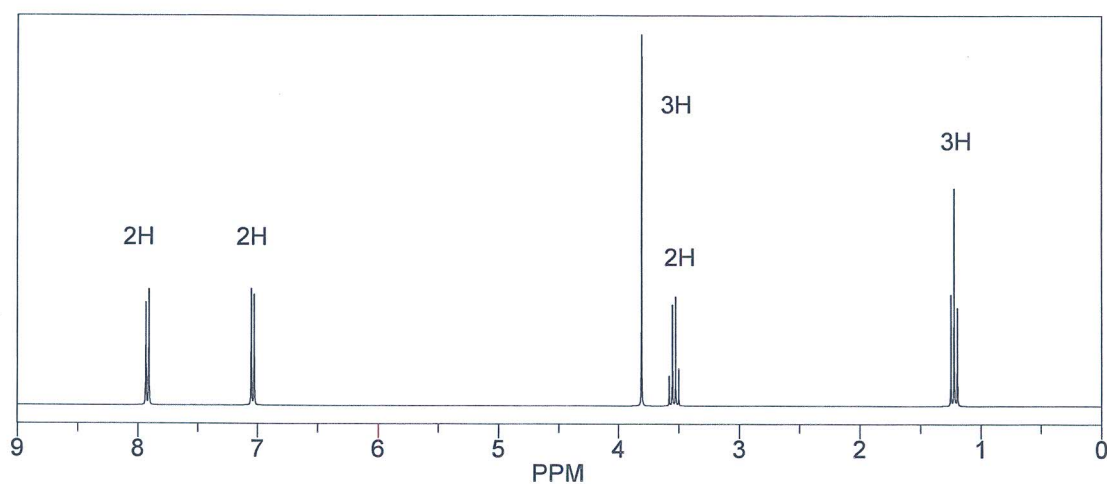
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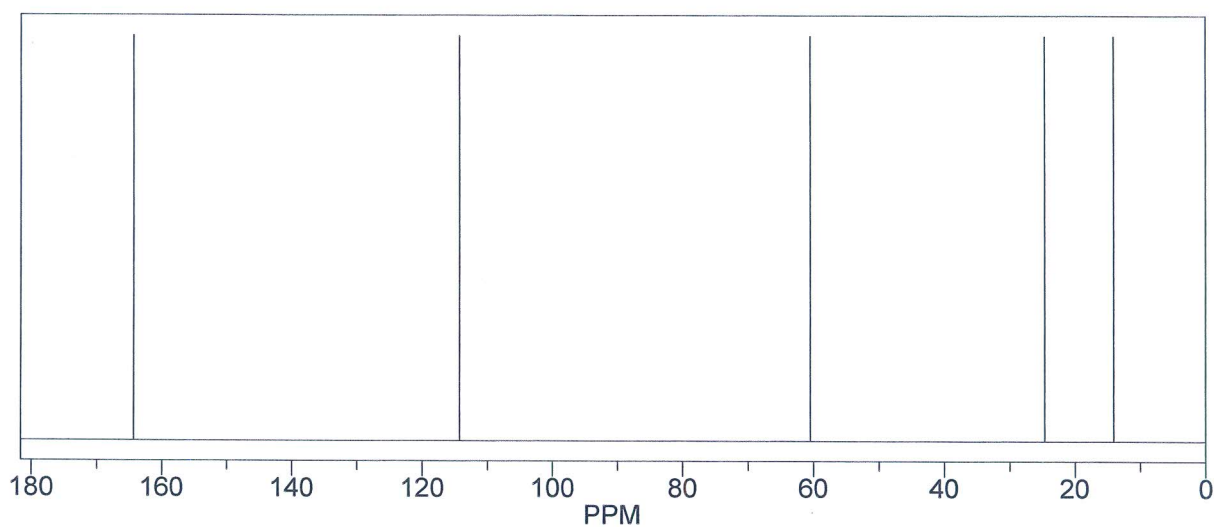
*請在【答案卷】作答

10. This compound has the molecular formula $C_{10}H_{12}O_2$. Following are the 1H NMR and ^{13}C NMR spectra. Use the spectra to propose a structure for this compound with explanation in detail. (6%)

1H NMR



^{13}C NMR



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*請在【答案卷】作答

Part 2 單選題

(30%, 1.5% each)

- Which of the following terms describes backbone structure of DNA?
(A) Sugar glycosides (B) Pairs of complementary bases
(C) Polyphosphate esters of 1,3-glycols (D) Pyrophosphates
- What is the mechanism of RNA backbone hydrolysis?
(A) E₁ (B) E₂
(C) S_N1 (D) S_N2
- Which of the following chemicals are suitable *N*-protected glycines useful in peptide synthesis?
I. C₆H₅(C=O)NHCH₂COOH II. C₆H₅O(C=O)NHCH₂COOH
III. (CH₃)₃C(C=O)NHCH₂COOH IV. (CH₃)₃CO(C=O)NHCH₂COOH
(A) I, II (B) I, III
(C) II, III (D) II, IV
- Arrange the following compounds according to increasing order of acidity of indicated carboxyl groups underlined.
I. CH₃COOH II. CH₃(C=O)NHCH₂COOH III. H₂NCH₂COOH
(A) I, II, III (B) II, III, I
(C) III, II, I (D) I, III, II
- How many triglycerides (including stereoisomers) are possible that have 2 different acyl groups?
(A) 2 (B) 3
(C) 4 (D) 5

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6. Which of the following reactions will proceed under normal condition?
- I. $\text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{N}^+\text{H}_3 + ^-\text{OH}$
II. $\text{CH}_3\text{NH}_2 + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{N}^+\text{H}_3 + \text{CH}_3\text{COO}^-$
III. $\text{CH}_3\text{NH}_2 + (\text{CH}_3)_3\text{N} \rightarrow \text{CH}_3\text{N}^-\text{H} + (\text{CH}_3)_3\text{N}^+\text{H}$
IV. $\text{CH}_3\text{NH}_2 + \text{C}_6\text{H}_5\text{N}^-\text{H} \rightarrow \text{CH}_3\text{N}^-\text{H} + \text{C}_6\text{H}_5\text{NH}$
- (A) I, II (B) I, III
(C) II, IV (D) III, IV
7. Arrange the following compounds with decreasing order of boiling point.
- I. $\text{C}_6\text{H}_5(\text{C}=\text{O})\text{CH}_3$ II. $\text{C}_6\text{H}_5\text{C}(\text{CH}_3)\text{HOH}$
III. $\text{C}_6\text{H}_5\text{CO}_2\text{H}$ IV. $\text{C}_6\text{H}_5\text{CO}_2^-\text{Na}^+$
- (A) I, II, III, IV (B) II, III, IV, I
(C) III, IV, II, I (D) IV, III, II, I
8. Compound X has a strong sharp peak at $1,700\text{ cm}^{-1}$ and a weak band at $2,700\text{ cm}^{-1}$. Its proton NMR spectrum has signals at 7.0 ppm and 9.5 ppm in addition to other signals. What is the most like structure of X?
- (A) $(\text{C}_6\text{H}_5)_2\text{C}=\text{O}$ (B) $\text{CH}_3\text{CH}_2\text{CHO}$
(C) $\text{C}_6\text{H}_5\text{CHO}$ (D) $\text{CH}_3\text{CH}_2(\text{C}=\text{O})\text{CH}=\text{CH}_2$
9. How many carbon resonance are there in ^{13}C NMR spectrum of *p*-HO(C₆H₄)CH₃?
- (A) 6 (B) 5
(C) 4 (D) 3
10. What is index of hydrogen deficiency for a compound having a molecular formula of C₆H₆N₂O?
- (A) 3 (B) 4
(C) 5 (D) 6
11. What is the base peak in mass spectrum expected for methylcyclopentane?
- (A) 28 (B) 43
(C) 57 (D) 84

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12. Which of the following statements characterize the reaction of *R*-3-chlorocyclopentene with sodium iodide in acetone?
- I. The reaction involves a carbocation intermediate
 - II. The reaction involves inversion of configuration
 - III. The reaction involves retention of configuration
 - IV. The reaction gives predominately a racemic product
- (A) I (B) II
(C) I, IV (D) I, III
13. How many stereoisomers can be formed from acid-catalyzed hydration of 4-methylcyclohexene?
- (A) 2 (B) 4
(C) 6 (D) 8
14. The specific rotation of dextrorotatory compound **Z** is +12.7 degrees. A mixture of dextrorotatory and levorotatory compound **Z** has a specific rotation of +6.35 degrees. What is optical purity of the mixture?
- (A) 25% (B) 33.3%
(C) 50% (D) 75%
15. Which of the following compounds contain stereocenters?
- I. Chlorocyclohexane
 - II. 2-methylpentane
 - III. 2-hydroxypropanoic acid
 - IV. 3-methyl-2-butanol
- (A) I, II (B) III, IV
(C) I, III (D) II, IV
16. What is the bonding of the carbon-carbon bonds in 1,3-butadiene?
- (A) s-s, p (B) sp^3 - sp^3 , p-p
(C) s-p, sp^2 - sp^2 (D) sp^2 - sp^2 , π

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17. Which of the following react with alkenes by a free radical mechanism?

I. H_2

II. HBr /peroxides

III. CCl_4

IV. $Hg(OAc)_2/H_2O$

(A) I, II

(B) III, IV

(C) I, IV

(D) II, III

18. Which of the following alkenes show *cis-trans* isomerization?

I. 1-chloropropene

II. 3-methylcyclohexene

III. 2,6-dimethyl-2,5-octadiene

IV. 3-ethyl-3-methyl-1-pentene

(A) I, II

(B) II, III

(C) III, IV

(D) I, III

19. What is a reasonable explanation for the following observation?

H_3O^+ is a stronger acid than NH_4^+

I. Electronegativity

II. Resonance

III. Hybridization

(A) I, II

(B) I, III

(C) II

(D) I

20. Which of the following are more stable isomers?

I. *cis* or *trans* 1,4-dibromocyclohexane

II. *cis* or *trans* 1,3-dibromocyclohexane

(A) I *cis* and II *cis*

(B) I *cis* and II *trans*

(C) I *trans* and II *cis*

(D) I *trans* and II *trans*