

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 110 學年度碩士班考試入學試題

系所班組別：生命科學院

乙組(化學與生醫工程組)

科目代碼：0502

考試科目：有機化學

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

國立清華大學 110 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

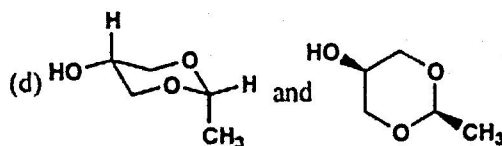
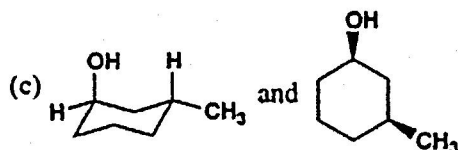
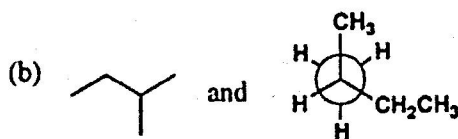
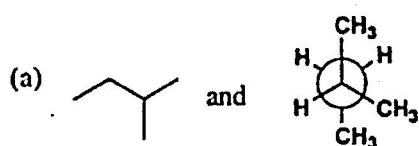
考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 1 頁

*請在【答案卷】作答

Part 1 簡答題 (70%)

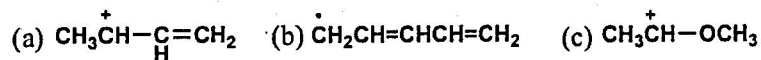
1. Does each of the following pairs of structures show the same molecule or different molecules? (6%)



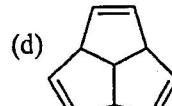
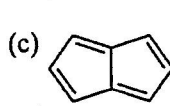
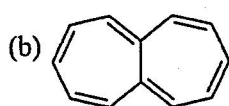
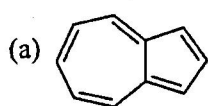
2. Draw the most stable conformation of each of the *cis* and *trans* isomers of the following: (6%)

- (a) 4-phenylcyclohexanol (b) 1-bromo-3-chlorocyclohexane
(c) 1-*t*-butyl-2-methylcyclohexane (d) 1-isopropyl-4-methylcyclohexane

3. Draw alternative resonance forms for each of the following and explain which is the most important contributor to the resonance hybrid. (6%)



4. Discuss possible aromaticity in each of the following. (6%)



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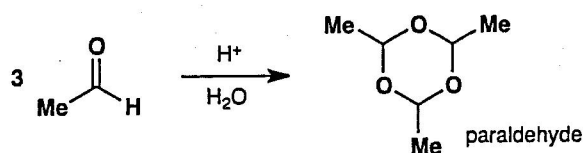
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

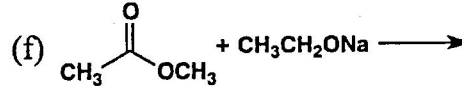
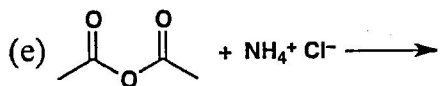
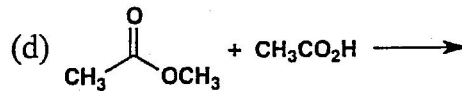
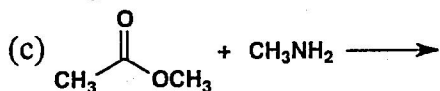
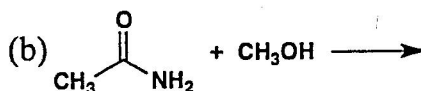
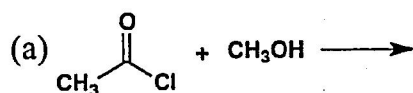
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*請在【答案卷】作答

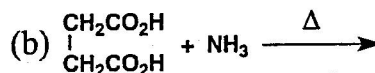
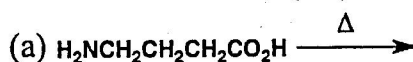
5. Ethanal gives a cyclic trimer called paraldehyde in the presence of a catalytic amount of acid and moisture. Propose a mechanism for this reaction. (6%)



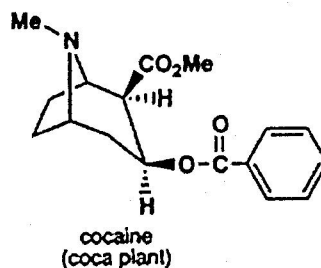
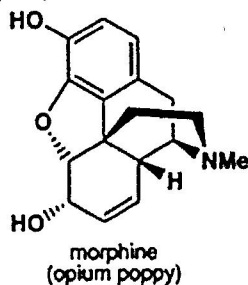
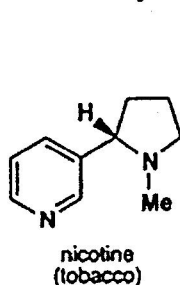
6. What are the main products, if any, of the following reactions? For those where you think there will be no reaction, give your reasons. (6%)



7. Identify the structures of the main products of the following reactions by giving curly arrow mechanisms. (6%)



8. The following are natural amines called alkaloids. Assign *R* or *S* configuration to all the chirality centers. (5%)



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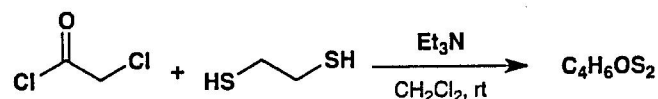
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

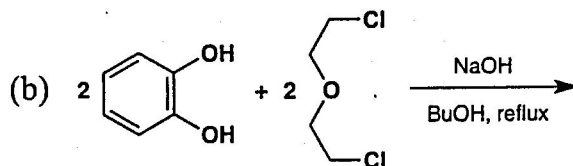
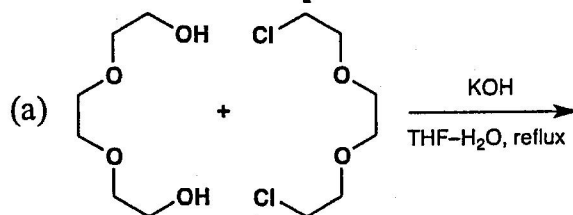
共 13 頁，第 3 頁

*請在【答案卷】作答

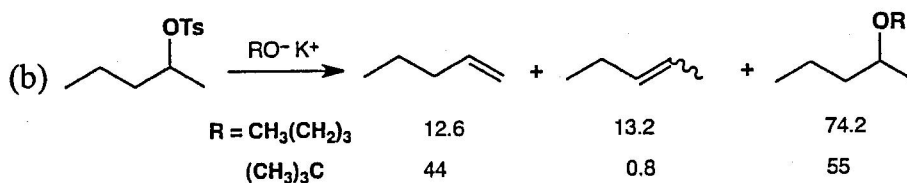
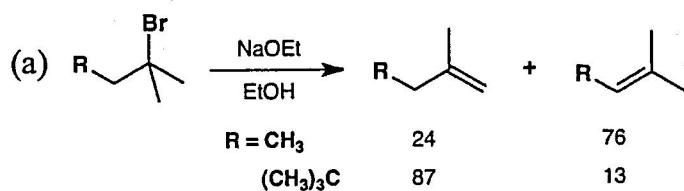
9. Give a mechanism for the following reaction and deduce the structure of the product. (5%)



10. Draw the structure of a main product of each of the following reactions. (4%)



11. The following results show relative % ratios of products in two pairs of reactions. Explain the different selectivity in each pair. (6%)



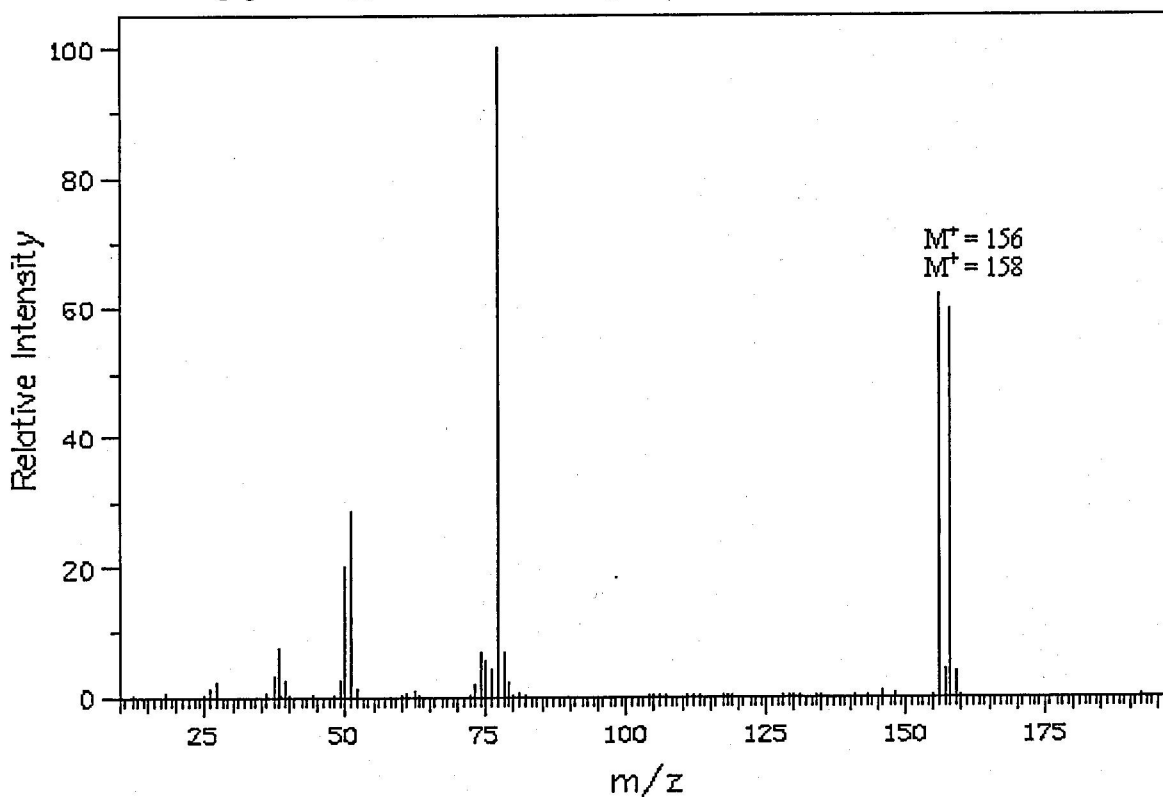
國立清華大學 110 學年度碩士班考試入學試題

系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 4 頁 *請在【答案卷】作答

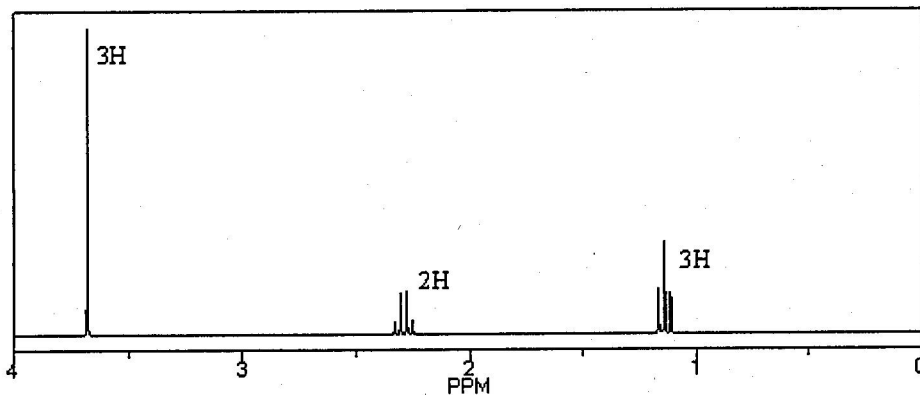
12. The following question(s) refer to the mass spectrum shown below. (4%)



The base peak in this spectrum occurs at a m/z of _____.

This compound contains C, H, and one other atom. The other atom from the mass spectrum is _____.

13. Identify the compound ($C_4H_6O_2$) that gives the following 1H NMR spectrum. (4%)



國立清華大學 110 學年度碩士班考試入學試題

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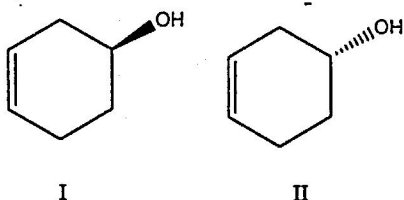
考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 5 頁

*請在【答案卷】作答

Part 2 單選題 (30%, 1.5% each)

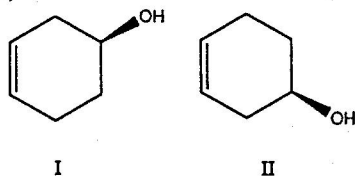
1) What is the relationship between alcohols I and II?



They are:

- a) different conformations of the same compound.
- b) constitutional isomers.
- c) enantiomers.
- d) diastereomers.
- e) identical.

2) What is the relationship between alcohols I and II?



They are:

- a) different conformations of the same compound.
- b) constitutional isomers.
- c) enantiomers.
- d) diastereomers.
- e) identical.

國立清華大學 110 學年度碩士班考試入學試題

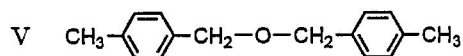
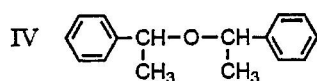
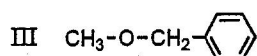
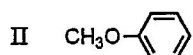
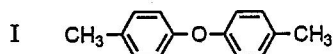
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 6 頁

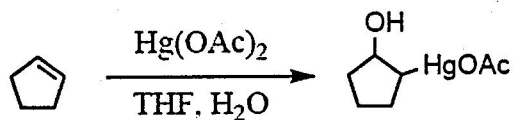
*請在【答案卷】作答

3) Select the structure of benzyl methyl ether.



- a) I
- b) II
- c) III
- d) IV
- e) V

4) What is the nucleophilic species involved in the initial step of the reaction below?



- a) OH
- b) $\text{Hg}(\text{OAc})_2$
- c) H_2O
- d) Cyclopentene
- e) the THF/ H_2O complex

國立清華大學 110 學年度碩士班考試入學試題

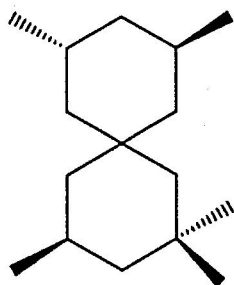
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 7 頁

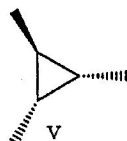
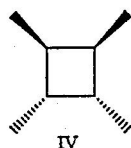
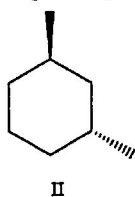
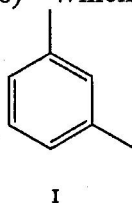
*請在【答案卷】作答

5) How many stereogenic centers are in the following compound?



- a) 1
- b) 3
- c) 4
- d) 5
- e) none of these choice

6) Which of the following compounds are chiral?



- a) I, IV, and V
- b) II only
- c) II and III
- d) III only
- e) all compounds are achiral

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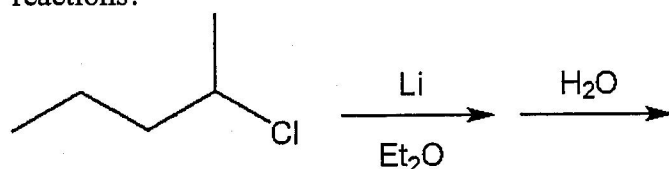
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 8 頁

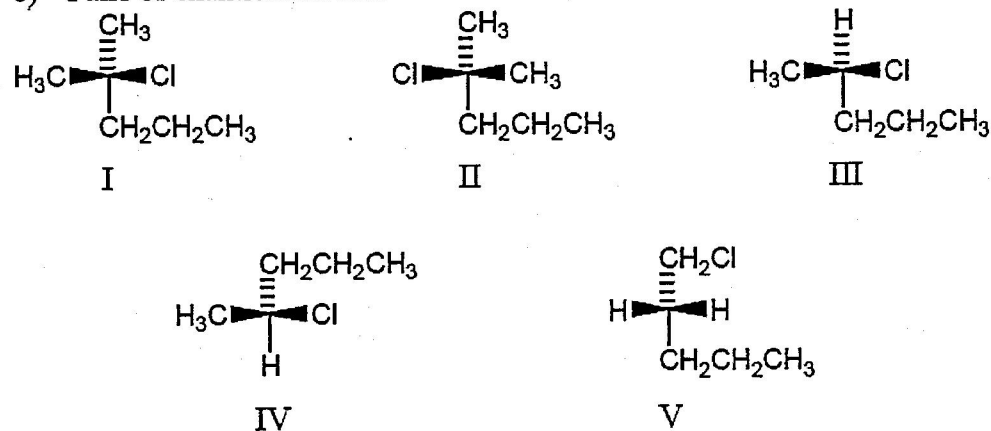
*請在【答案卷】作答

7) What is the major organic product obtained from the following sequence of reactions?



- a) 2-pentanol
- b) pentane
- c) 1-pentene
- d) (*E*)-2-pentene

8) Pairs of enantiomers are:



- a) I, II and III, IV
- b) I, II
- c) III, IV
- d) IV, V
- e) None of the structures.

國立清華大學 110 學年度碩士班考試入學試題

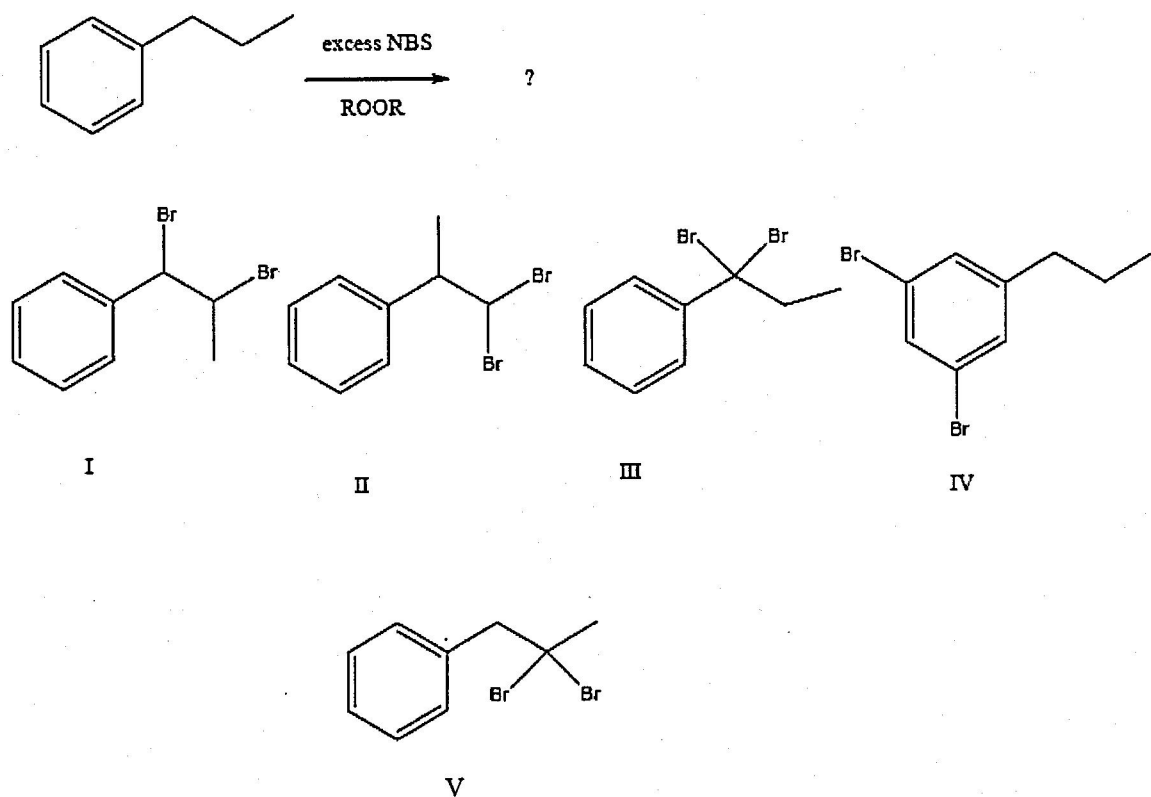
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 9 頁

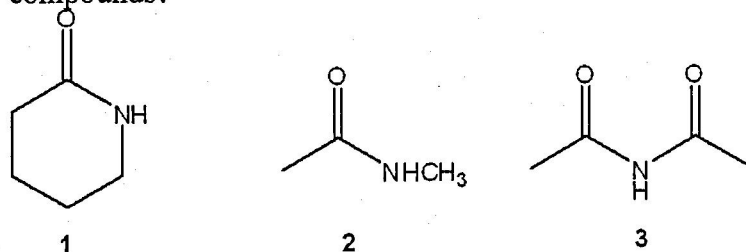
*請在【答案卷】作答

9) What would be the major product of the following reaction?



- a) I
- b) II
- c) III
- d) IV
- e) V

10) What is the correct assignment of the functional groups in the following compounds?



- a) 1 = amide; 2 = imide; 3 = nitrile
- b) 1 = lactam; 2 = amide; 3 = imide
- c) 1 = lactam; 2 = imide; 3 = amide
- d) 1 = imide; 2 = amide; 3 = lactam

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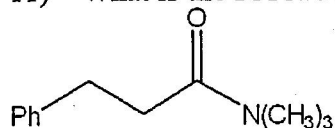
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共 13 頁，第 10 頁

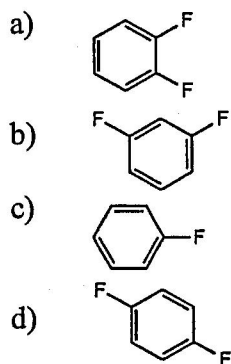
*請在【答案卷】作答

11) What is the IUPAC name of the following compound?

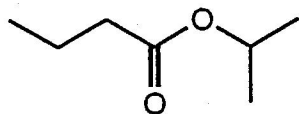


- a) dimethylamino-3-phenylpropanoic acid
- b) *N,N*-dimethyl 2-phenylethyl amide
- c) *N,N*-dimethyl 3-phenylpropanamide
- d) dimethyl 2-phenylpropanoylamine

12) Which molecule does not have a dipole moment?



13) What alkyl group is attached to the oxygen in the following ester?



- a) ethyl
- b) propyl
- c) *sec*-propyl
- d) isopropyl
- e) None of these choices.

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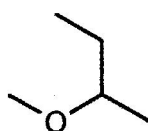
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

共 13 頁，第 11 頁

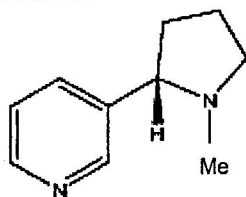
*請在【答案卷】作答

14) What alkyl groups make up the following ether?



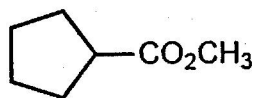
- a) Isobutyl and methyl
- b) Methyl and butyl
- c) Ethyl and isopropyl
- d) Methyl and *sec*-butyl
- e) None of these choices.

15) What functional groups are present in nicotine, an addictive substance found in tobacco?



- a) two tertiary amines
- b) two secondary amines
- c) phenyl ring and tertiary amine
- d) secondary and tertiary amine
- e) none of these choices

16) What functional group is present in the following compound?



- a) alcohol
- b) ketone
- c) aldehyde
- d) ester
- e) ether

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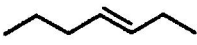
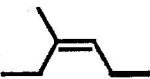
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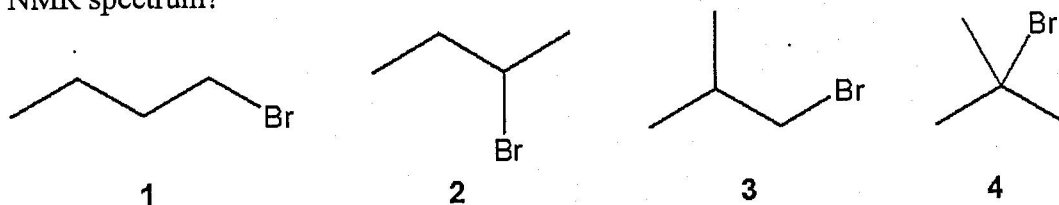
共 13 頁，第 12 頁

*請在【答案卷】作答

17) IR evidence for the presence of the C=C would be most difficult to detect in the case of which of these alkenes?

- a) 
- b) 
- c) 
- d) 
- e) 

18) Which C_4H_9Br compound gives a triplet at approximately 3.5 ppm in the 1H NMR spectrum?



- a) 1
b) 2
c) 3
d) 4

國立清華大學 110 學年度碩士班考試入學試題

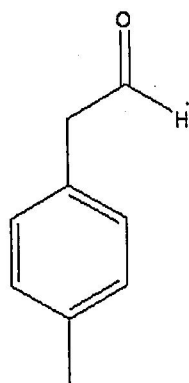
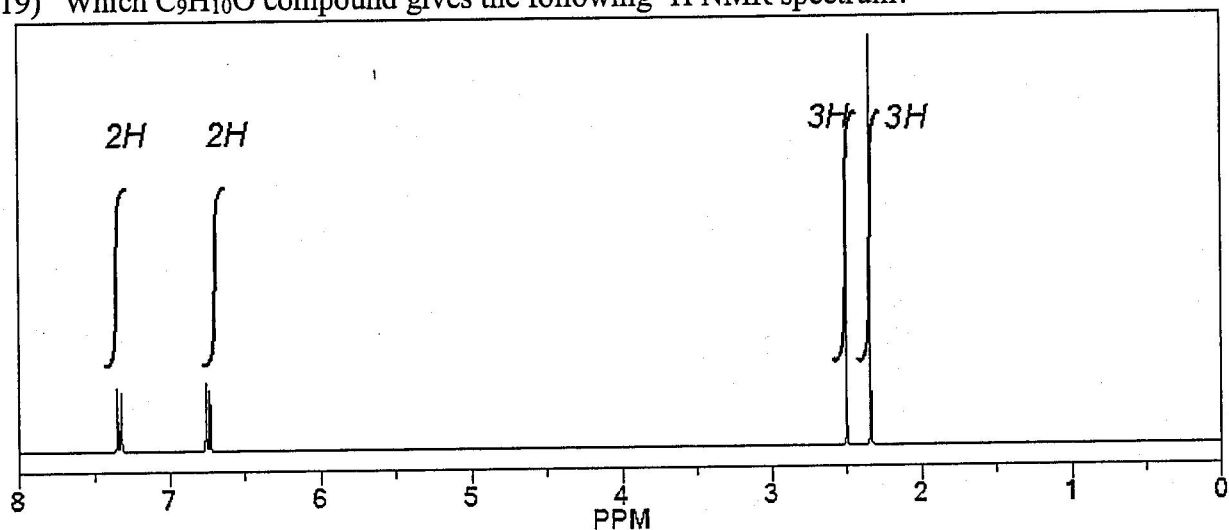
系所班組別：生命科學院乙組、丁組

考試科目（代碼）：有機化學(0502、0706)

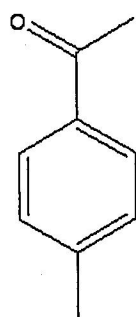
共 13 頁，第 13 頁

*請在【答案卷】作答

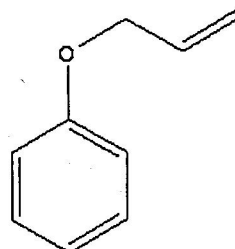
19) Which $C_9H_{10}O$ compound gives the following 1H NMR spectrum?



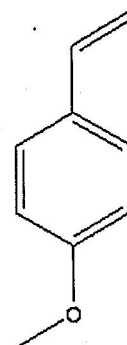
1



2



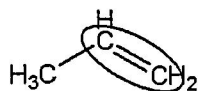
3



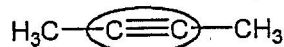
4

- a) 1
- b) 2
- c) 3
- d) 4

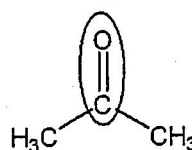
20) Which of the following bonds (circled) gives the weakest absorbance in the infrared spectrum?



1



2



3



4