

國 立 清 華 大 學 命 題 紙

98 學年度\_\_生命科學院、生命科學院醫學生物科技學程\_\_系(所)\_\_乙\_\_組碩士班入學考試

科目\_\_有機化學\_\_ 科目代碼\_\_0302、0506\_\_共\_\_7\_\_頁第\_\_1\_\_頁 \*請在【答案卷】內作答

PART I. 單選題，共二十題 (2 points each)

- Which of the following species have bond angle of about  $109^\circ$ ?  
I.  $\text{NH}_3$       II.  $\text{CO}_2$       III.  $\text{H}_2\text{O}$       IV.  $\text{H}_3\text{O}^+$       V.  $\text{O}_3$   
(A) I, III, IV (B) II, III, V (C) I, IV (D) III, IV, V
- What are the correct orbital hybridizations for carbon in the following species?  
I.  $\text{CH}_3^-$       II.  $\text{CH}_4$       III.  $\text{CH}_3^+$   
a.  $sp$       b.  $sp^2$       c.  $sp^3$   
(A) I  $\rightarrow$  a, II  $\rightarrow$  c (B) II  $\rightarrow$  a, III  $\rightarrow$  b (C) I  $\rightarrow$  c, III  $\rightarrow$  b (D) II  $\rightarrow$  c, III  $\rightarrow$  c
- Which of the following are constitutional isomers of 4-isopropyloctane?  
I. 3-ethyl-2,4,5-trimethyloctane      II. isobutylcyclohexane  
III. 2,2-dimethyl-4-ethylheptane      IV. 4-ethyl-2-methyloctane  
(A) I, IV (B) II, III (C) I, II (D) III, IV
- What is the percent ionization of acetic acid at pH 2.76 ( $\text{pK}_a=4.76$ )?  
(A) 100% (B) 50% (C) 10% (D) 1%
- What is a reasonable explanation of the following observation?  
Acetylene is a stronger acid than ethane.  
I. electronegativity      II. resonance      III. hybridization  
(A) I, II (B) I, III (C) II, III (D) I
- Arrange the following compounds in the order of increasing bond length for the carbon-carbon single bond.  
I.  $\text{CH}_3-\text{CH}_3$       II.  $\text{CH}\equiv\text{C}-\text{CH}_3$       III.  $\text{CH}_3-\text{CH}=\text{CH}_2$       IV.  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$   
(A) I, III, II, IV (B) II, IV, III, I (C) IV, II, III, I (D) I, III, IV, II
- How many pairs of *cis-trans* isomers are possible for the product from dehydrohalogenation of 3-bromo-hexane?  
(A) 1 (B) 2 (C) 3 (D) 4
- What is the product from the reaction of butyne with  $\text{H}_2\text{SO}_4$  and  $\text{HgSO}_4$ ?  
(A)  $\text{CH}_3\text{CH}_2\text{COCH}_3$       (B)  $\text{CH}_3\text{CH}_2\text{CHCHO}$   
(C)  $\text{CH}_3\text{CH}_2\text{COHCH}_2$       (D)  $\text{CH}_3\text{CH}_2\text{CHCH}_2$

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9. How many different alkenes with the molecular formula  $C_5H_9Cl$  are chiral?  
(A) 2 (B) 3 (C) 4 (D) 5
10. Which of the following can be resolved into a pair of enantiomers?  
(A) *cis*-1,2-dichlorocyclobutane (B) *trans*-1,2-dichlorocyclobutane  
(C) *cis*-1,3-dichlorocyclobutane (D) *trans*-1,3-dichlorocyclobutane
11. Which of the following alcohols is most likely to form rearranged products from the reaction with HBr?  
(A)  $(CH_3)_2COHCH_2CH_3$  (B)  $(CH_3)_2CHCHOHCH_3$   
(C)  $(CH_3)_2CHCH_2CH_2OH$  (D)  $(CH_3)_3CH_2OH$
12. What are the best conditions for preparing 2-iodohexane from 1-hexene?  
(A)  $I_2$  and heat (B) HI (C) HI and peroxides (D)  $HIO_4$
13. What are the products from the reaction of diisopropyl ether with  $BBr_3$  followed by  $H_2O$ ?  
(A)  $CH_3CH_2CH_2Br$  (B)  $CH_2=CHCH_3$   
(C) 2  $(CH_3)_2CHBr$  (D)  $(CH_3)_2CHBr + (CH_3)_2CHOH$
14. The mass spectrum of a compound showed a molecular ion peak at  $M$  and another at  $M+2$  in the ratio of 3:1. Which of the following heteroatoms does the compound have?  
(A) O (B) Cl (C) Br (D) N
15. Which of the following compounds have an absorption in the UV greater than 200 nm?  
I. 1,2-pentadiene II. 1,3-pentadiene III. 1,4-pentadiene  
IV. 2,3-pentadiene V. 2,4-hexadiene  
(A) II, V (B) I, IV (C) II, III (D) III, IV
16. What is the order of increasing reactivity toward electrophilic aromatic substitution for the following compounds?  
I.  $C_6H_5CH_3$  II.  $C_6H_5Br$  III.  $C_6H_5CH_2Br$  IV.  $C_6H_5CHBr_2$   
(A) II, I, IV, III (B) I, III, IV, II (C) III, IV, I, II (D) II, IV, III, I
17. Which of the combinations of reactions is best for preparation of the following compound  $C(CH_2OH)_4$ ?  
(A) Wittig/Cannizzaro (B) Grignard/Clemmensen  
(C) Aldol condensation/Cannizzaro (D) Baeyer-Villiger

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18. Which of the following reaction conditions will convert glucose to 2,3,4,6-tetra-*O*-methyl-D-glucose?  
(A)  $\text{CH}_3\text{OH}/\text{HCl} \rightarrow$  (B)  $\text{CH}_3\text{OH}/\text{HCl} \rightarrow (\text{CH}_3)_2\text{SO}_4/\text{NaOH} \rightarrow$   
(C)  $(\text{CH}_3)_2\text{SO}_4/\text{NaOH} \rightarrow$  (D)  $\text{CH}_3\text{OH}/\text{HCl} \rightarrow (\text{CH}_3)_2\text{SO}_4/\text{NaOH} \rightarrow \text{H}_2\text{O}/\text{HCl}$
19. Ethyl benzoate is reacted with ethyl acetate in a solution of sodium ethoxide. The product is treated with sodium ethoxide and ethyl bromide, followed by reaction with aqueous acid and then heat. What is the most reasonable product from these reactions?  
(A)  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{COCH}_3$  (B)  $\text{C}_6\text{H}_5\text{COCH}_2\text{COOCH}_2\text{CH}_3$   
(C)  $\text{C}_6\text{H}_5\text{COCH}_2\text{CH}_2\text{CH}_3$  (D)  $\text{C}_6\text{H}_5\text{CH}_2\text{COCH}_2\text{CH}_3$
20. A polypeptide has the following proportions of amino acids:  
Gly (1) Leu (1) Val (1) Phe (2)  
Treatment of the pentapeptide with chymotrypsin gave the following fragments:  
Gly-Val Leu Phe  
What is the structure of the polypeptide?  
(A) PhePheGlyValLeu (B) GlyValPheLeuPhe  
(C) LeuGlyValPhePhe (D) PheLeuGlyValPhe

PART II. 問答題

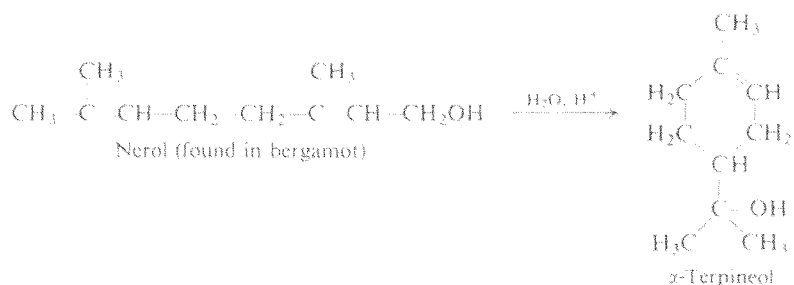
1. Starting from (R)-*sec*-butyl alcohol, and using any optically inactive reagents, show all steps in the synthesis of  
(a) (R)-*sec*-butyl ethyl ether ( $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{OC}_2\text{H}_5$ ) (3 points)  
(b) (S)-*sec*-butyl ethyl ether (3 points)
2. A hydrocarbon, A, adds one mole of hydrogen in the presence of a platinum catalyst to form n-hexane. When A is oxidized vigorously with  $\text{KMnO}_4$ , a single carboxylic acid containing three carbon atoms is isolated. Give the structure and name of A. (3 points)
3. The following reaction is carried out, and the products are separated by careful distillation, recrystallization, or chromatography. For the reaction, tell how many fractions will be collected? Draw a stereochemical formula of the compound or compounds making up each fraction. Tell whether each fraction, as collected, will be optically active or inactive? (3 points)  
Racemic (E)-4-methyl-2-hexene -  $\text{Br}_2$  ---->  $\text{C}_6\text{H}_{12}\text{Br}_2$

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4. Suggest a mechanism for the conversion of nerol into  $\alpha$ -terpineol in the presence of dilute  $\text{H}_2\text{SO}_4$ . (3 points)



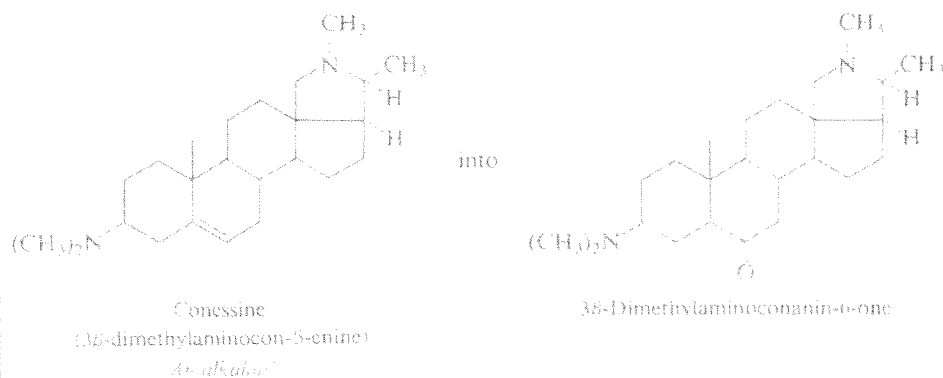
5. Predict the *major* products of the following reactions.



(c) What is the function of  $\text{AlBr}_3$  in (b)? Why is it needed here? (2 points)

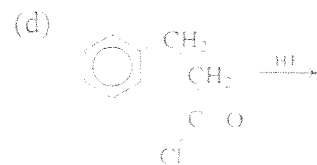
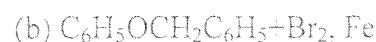
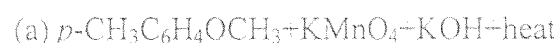
6. The compound indene,  $\text{C}_9\text{H}_8$ , found in coal tar, rapidly decolorizes  $\text{Br}_2/\text{CCl}_4$  and dilute  $\text{KMnO}_4$ . Only one mole of hydrogen is absorbed readily to form indane,  $\text{C}_9\text{H}_{10}$ . More vigorous hydrogenation yields a compound of formula  $\text{C}_9\text{H}_{16}$ . Vigorous oxidation of indene yields phthalic acid. What is the structure of indene? Of indane? (3 points)

7. Making use of any necessary organic or inorganic reagents, outline all steps in the conversion of



(3 points)

8. Write down the products for the following reactions. (3 points each)

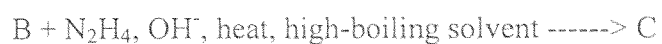


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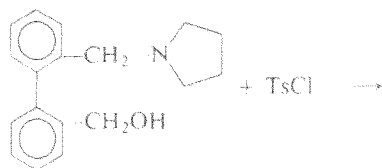
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9. What are A, B, and C? (6 points)



10. What's the product of the following reaction? What's the role of tosyl chloride? (3 points)



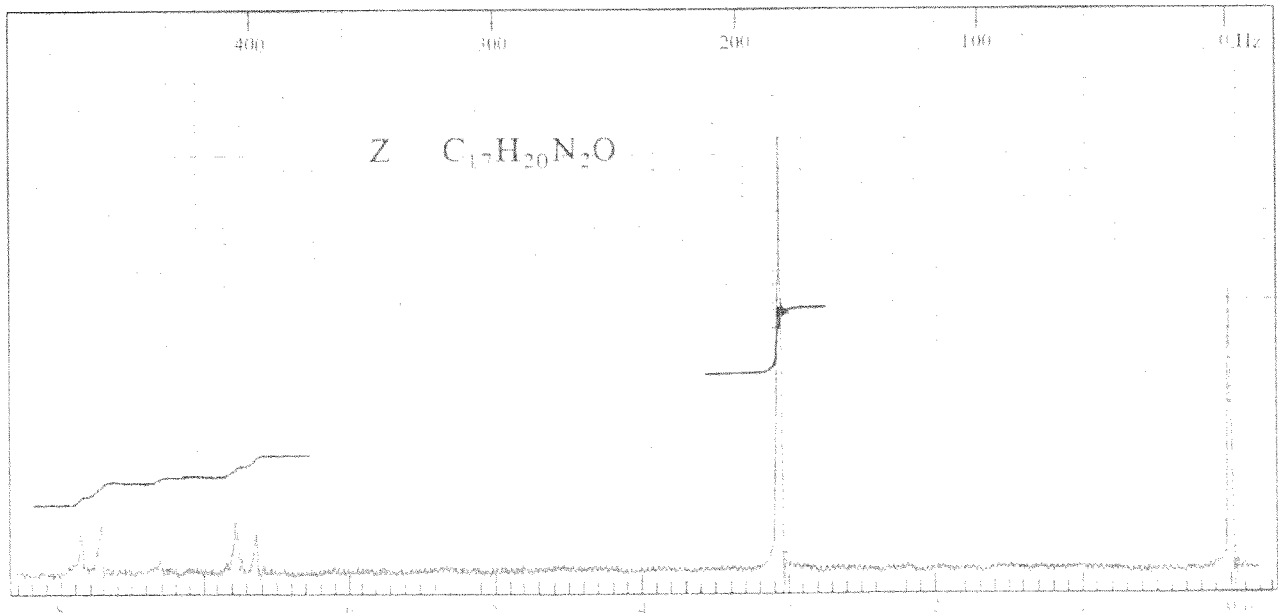
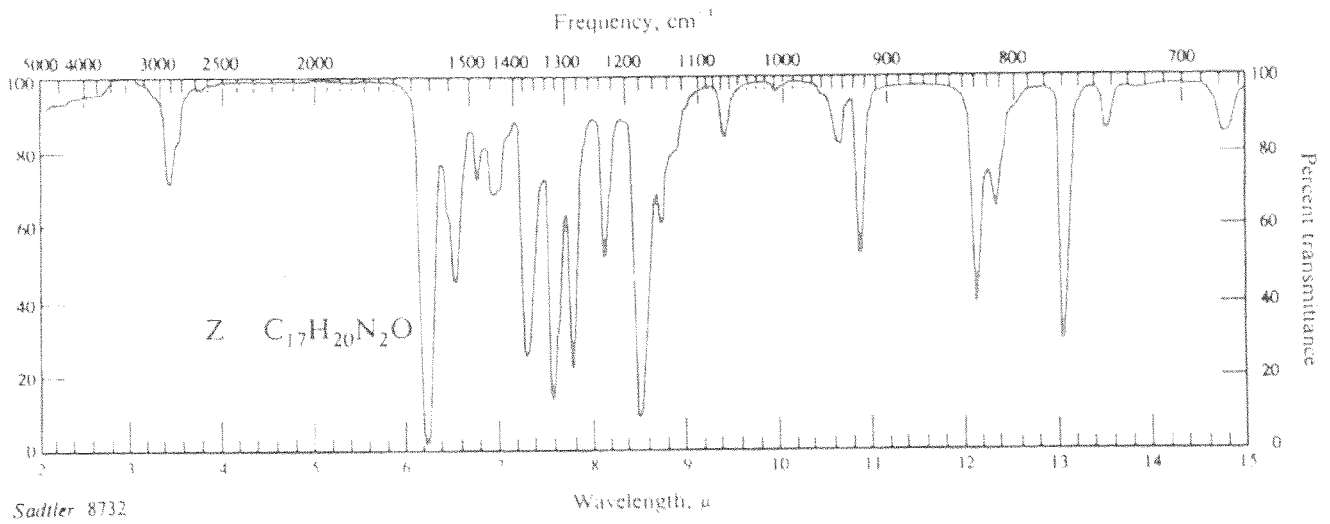
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PART III. 光譜分析

1. Give the structure of the compound Z according to the IR and NMR spectrum. (5 points)



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2. Give the structure of the compound SS on the basis of the IR and NMR spectrum. (5 points)

