

國立臺北科技大學 113 學年度碩士班招生考試

系所組別：3520 化學工程與生物科技系化學工程碩士班乙組

第二節 有機化學 試題

第 1 頁 共 2 頁

注意事項：

1. 本試題共二大題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、單選題 (每題 2 分 共 60 分)

1. What is the relationship of the two structures shown below?



(A) identical (B) constitutional isomers (C) enantiomers (D) diastereomers

2. Which of the following molecules
- has**
- a dipole moment?

(A) CBr_4 (B) $\text{CH}_2=\text{CH}_2$ (C) BF_3 (D) SO_2

3. Which of the following compounds may be classed as a protic solvent?

(A) tert-butanol (B) diether ether (C) n-hexane (D) acetone

4. In order for a reagent to behave as a nucleophile it
- must**
- have (A) an overall positive charge (B) an overall negative charge (C) a non-bonding electron pair (D) a nitrogen or sulfur atom

5. Which of the following species has a planar molecular configuration? (A)
- SO_3^{2-}
- (B)
- SOCl_2
- (C)
- SO_3
- (D)
- SO_2Cl_2

6. Which of the following covalent compounds
- does not**
- have any formally charged atoms? (A)
- $(\text{CH}_3)_3\text{NO}$
- (B)
- $\text{CH}_2=\text{N}=\text{N}$
- (C)
- $\text{CH}_3\text{-O-N=O}$
- (D)
- $\text{CH}_3\text{C}\equiv\text{NO}$

7. Limiting your answer to cycloalkane and ignoring stereoisomers, how many
- C_6H_{12}
- constitutional isomers are there? (A) 6 (B) 9 (C) 12 (D) 13

8. The preferred conformation of cis-1,3-dimethylcyclohexane is (A) chair-diaxial (B) chair-diequatorial (C) chair-one axial / one equatorial (D) boat-mixed orientation

9. Which of the following
- C_6H_{12}
- isomers has the largest heat of combustion? (A) cyclohexane (B) methylcyclopentane (C) ethylcyclobutane (D) propylcyclopropane

10. The product from
- OsO_4
- hydroxylation of trans-2-butene will be (A) achiral (B) optically active (C) racemic (D) a meso compound

11. What is the relative rate of addition of
- HBr
- to I: 1,3-pentadiene; II: 1,4-pentadiene; and III: 1-pentyne? (A) I>II>III (B) III>II>I (C) II>I>III (D) III>I>II

12. A chiral
- C_6H_{12}
- hydrocarbon undergoes catalytic hydrogenation to yield an achiral
- C_6H_{14}
- product. What is the starting compound? (A) cis-2-hexene (B) 3-methyl-pentene (C) 4-methyl-2-pentene (D) 3-methyl-2-pentene

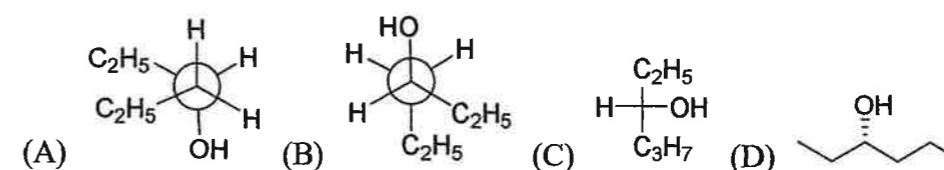
13. Which of the following compounds is
- unlikely**
- to react with sodium metal? (A)
- $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$
- (B)
- $\text{C}_2\text{H}_5\text{OH}$
- (C)
- $\text{C}_2\text{H}_5\text{Br}$
- (D)
- $\text{C}_2\text{H}_5\text{NH}_2$

14. Which of the following isomeric chlorides will undergo
- $\text{S}_\text{N}2$
- substitution most readily? (A) 4-chloro-1-butene (B) 1-chloro-1-butene (cis or trans) (C) 1-chloro-2-butene (cis or trans) (D) 2-chloro-1-butene

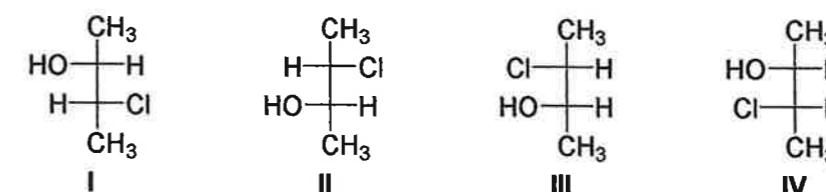
15. A
- $\text{C}_6\text{H}_{14}\text{O}$
- chiral alcohol is converted to a bromide by treatment with
- PBr_3
- . Reaction of this bromide, first with
- Mg
- in ether, followed by quenching in 0.1N
- HCl
- produces an achiral
- C_6H_{14}
- hydrocarbon. Which of the following is the original alcohol? (A) 2-ethyl-1-butanol (B) 4-methyl-1-pentanol (C) 3-methyl-3-pentanol (D) 3-methyl-1-pentanol

16. Which of the following reagents would be best for oxidizing a
- 1°
- alcohol to an aldehyde? (A)
- H_3PO_4
- (B) PCC in
- CH_2Cl_2
- (C) Jones' reagent (
- H_2CrO_4
-) (D)
- OsO_4

17. Which of the following is (R)-3-hexanol?



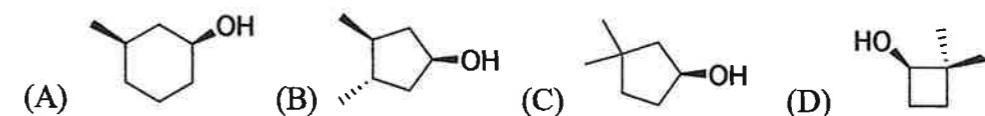
18. Which two Fischer formulas represent a pair of enantiomers?



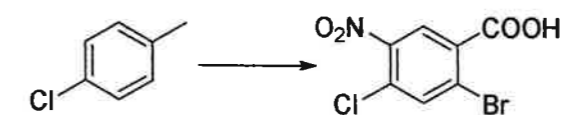
(A) I & II (B) III & IV (C) I & IV (D) II & III

19. Which of the following descriptive terms would never be applied to a pair of stereoisomers? (A) enantiomers (B) tautomers (C) diastereomers (D) epimers

20. A
- $\text{C}_7\text{H}_{14}\text{O}$
- optically active alcohol is oxidized by Jones' reagent to an optically inactive (achiral) ketone. Which of the following compounds meets these facts?



21. Which of the following procedures would be best for achieving the following reaction?

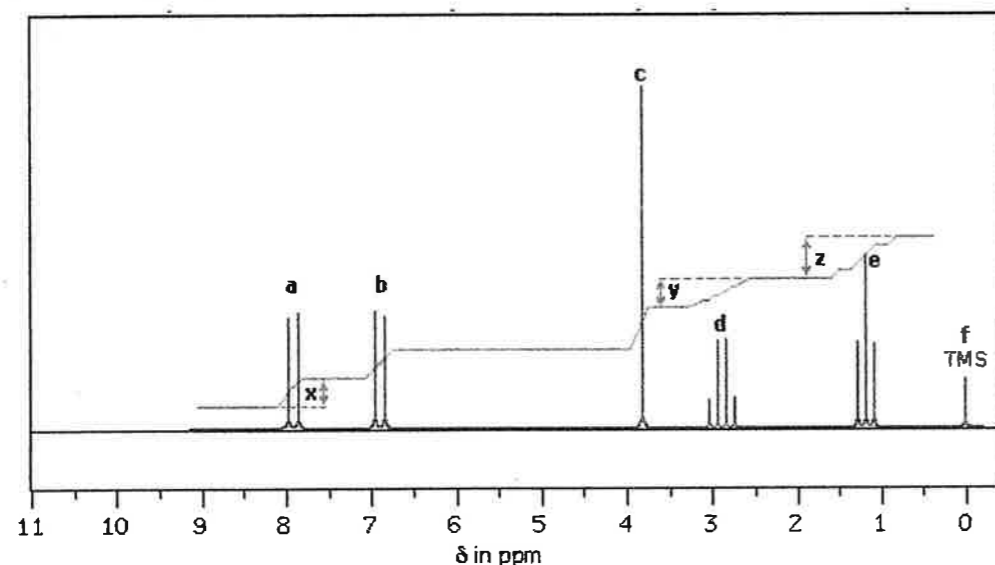


- (A) (i)
- $\text{Br}_2+\text{FeBr}_3$
- (ii)
- KMnO_4
- & heat (iii)
- HNO_3
- &
- H_2SO_4
- (B) (i)
- KMnO_4
- & heat (ii)
- $\text{Br}_2+\text{FeBr}_3$
- (iii)
- HNO_3
- &
- H_2SO_4
- (C) (i) NBS in
- CCl_4
- & heat (ii)
- KMnO_4
- & heat (iii)
- HNO_3

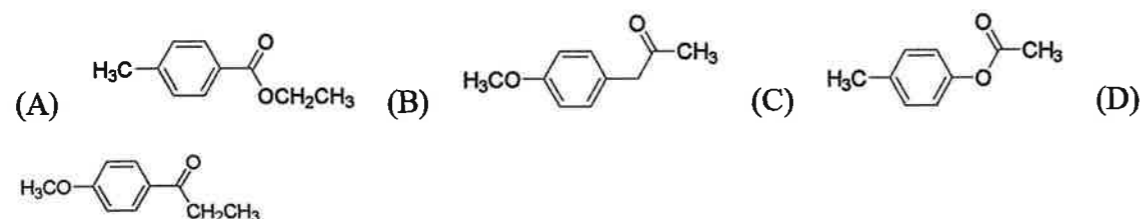
& H₂SO₄ (D) (i) NBS in CCl₄ & heat (ii) NaNO₂ & H₂SO₄ (iii) KMnO₄ & heat

22. The aromatic heterocyclic base pyridine is sulfonated by heating with concentrated sulfuric acid. Which of the following statements about this reaction is correct? (note that in numbering the ring nitrogen is #1) (A) pyridine reacts more rapidly than benzene and is sulfonated at C-3 (B) pyridine reacts more rapidly than benzene and is sulfonated at C-2 & C-4 (C) pyridine reacts more slowly than benzene and is sulfonated at C-3 (D) pyridine reacts more slowly than benzene and is sulfonated at C-2 & C-4

Questions 23 through 25 refer to the 90 MHz ¹H-NMR spectrum shown here (specific signals are labeled a through f)



23. Of all six signal groups in this spectrum, what is the multiplicity of the lowest field signal? (A) singlet (B) doublet (C) triplet (D) quartet
24. The two sharp signals that constitute the resonance marked a have chemical shifts of 7.82 and 7.95 ppm. What is the coupling constant for this doublet? (A) 0.13 MHz (B) 11.7 Hz (C) 11.7 MHz (D) 13Hz
25. If the spectrum is from a C₁₀H₁₂O₂ compound, having a strong absorption at 1680 cm⁻¹ in the infrared, what is its likely structure?



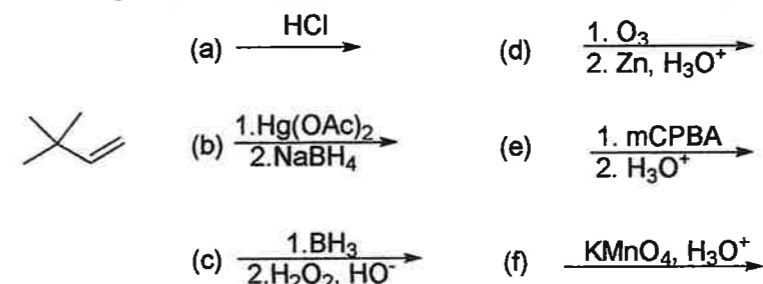
26. Which of the following isomers is most acidic? (A) 3,4-hexanedione (B) 2,5-hexanedione (C) 2,4-hexanedione (D) hexanedial
27. An aldol condensation is used to prepare 1,3-diphenyl-2-propenone. Which

combination of reactants will lead to this product? (A) enolate donor = acetaldehyde; carbonyl acceptor = benzaldehyde (B) enolate donor = phenylacetaldehyde; carbonyl acceptor = phenylacetaldehyde (C) enolate donor = acetophenone; carbonyl acceptor = benzaldehyde (D) enolate donor = propiophenone; carbonyl acceptor = benzaldehyde

28. Ethylmethylamine cannot be resolved under normal conditions. Why? (A) the favored configuration is not chiral (B) the nitrogen atom rapidly inverts its configuration leading to a racemic mixture (C) it isomerizes rapidly with the achiral isomer trimethylamine (D) the C-N bond is not stable under conditions used for resolution
29. Which of the following would not be a useful reaction for preparing isobutyric acid, (CH₃)₂CHCO₂H? (A) 2-methyl-1-propanol + Jones' reagent (B) 2-bromopropane + CO₂; followed by hydrolysis (C) cis-2,5-dimethyl-3-hexene + O₃; followed by H₂O₂ (D) 2-bromopropane + NaCN; followed by acid-catalyzed hydrolysis
30. The infrared spectrum of a hydrocarbon has a strong absorption at 3297 cm⁻¹. What structural feature does this indicate? (A) C≡C (B) sp³ C-H (C) sp² C-H (D) sp C-H

二、問答題(共 40 分)

1. (20 pts) Give the chemical structures and IUPAC names of the products with showing both regiochemistry and stereochemistry where appropriate.



2. (10 pts) The cyclohexa-1,3-diene reacted with 1 equivalent bromide and got different products at -70°C and 25°C, respectively. Show the mechanisms using the curved arrow formalism (4 pts) and the products with chemical structures and IUPAC names for this reaction (4 pts) and explain the phenomenon (2 pts).
3. (10 pts) Draw the mechanisms using the curved arrow for the following reactions (6 pts). Which one is thermodynamic product? (2 pts) Why (2pts)?

