

編號：F 55 系所：化學系

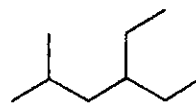
科目：有機化學

本試題是否可以使用計算機： 可使用， 不可使用（請命題老師勾選）

一、單選題（每題二分，答錯不倒扣）

1. Which of the following species has(have) a linear geometry? I. CO_2 II. NO_2^+ III. NO_2^-
 (A) only I (B) only II (C) I and II (D) I, II and III

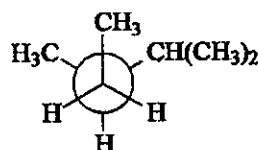
2. The correct IUPAC name of the compound X is
 (A) 4-ethyl-2-methylhexane (B) 3-ethyl-5-methylhexane
 (C) 2-methyl-4-ethylhexane (D) 5-methyl-3-ethylhexane



Compound X

3. What is the IUPAC name of the compound Y?

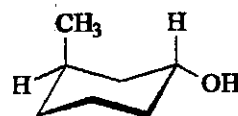
- (A) 1,2,3-trimethylbutane (B) 2,3-dimethylpentane
 (C) 2,3,4-trimethylpentane (D) 2-isopropylbutane



Compound Y

4. What is the IUPAC name of the compound Z?

- (A) *cis*-3-methylcyclohexanol (B) *trans*-3-methylcyclohexanol
 (C) *cis*-5-methylcyclohexanol (D) *trans*-5-methylcyclohexanol

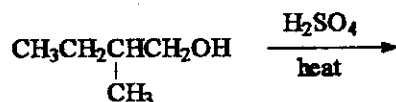


Compound Z

5. Which of the following is isobutyl alcohol?

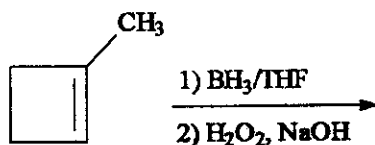
- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ (B) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ (C) $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ (D) $(\text{CH}_3)_3\text{COH}$

6. Predict the major product of the following reaction:



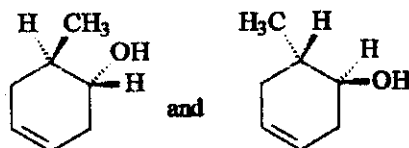
- (A) $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)=\text{CH}_2$ (B) $\text{CH}_3\text{CH}=\text{CCH}_2\text{CH}_3$ (C) $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$ (D) $(\text{CH}_3)_2\text{CHCH}=\text{CH}_2$

7. What is(are) the product(s) of the following hydroboration-oxidation reaction?



- (A) 1-methylcyclobutanol (B) *trans*-2-methylcyclobutanol
 (C) *cis*-2-methylcyclobutanol (D) equal amounts of *cis* and *trans* isomers

8. What is the relationship between the following two compounds?



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

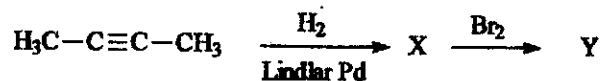
背面仍有題目，請繼續作答)

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9. Identify the major product(s) in the reaction of (R)-2-bromopentane with sodium cyanide in DMSO?

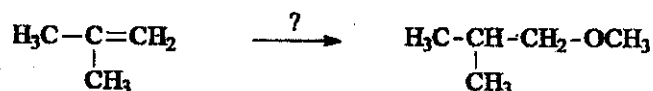
- (A) (R)-2-cyanopentane (B) (S)-2-cyanopentane
(C) racemic mixture of 2-cyanopentane (D) *trans*-2-pentene

10. Identify compound Y



- (A) 2-bromobutane (B) *meso*-2,3-dibromobutane
(C) racemic (2R,3R) and (2S,3S)-2,3-dibromobutane (D) 2,3-dibromo-2-butene

11. Which reaction sequence below would work best (and with highest yield) in the following conversion?



- (A) (1) H₂/Pt, (2) Br₂, light (3) CH₃ONa (B) (1) HBr, peroxides (2) CH₃OH, heat
(C) (1) NBS, CCl₄, heat (2) H₂/Pt (3) CH₃ONa (D) (1) NBS, CCl₄, heat (2) CH₃ONa (3) H₂/Pt

12. Which of the following ions are aromatic species?



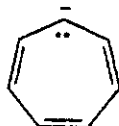
I



II



III



IV

- (A) I and III (B) II and III (C) II and IV (D) III and IV

13. Rank the following compounds in order of decreasing reactivity to aromatic electrophilic bromination.

I. benzene II. toluene III. benzoic acid IV. phenol

- (A) IV > II > I > III (B) IV > III > II > I (C) II > I > IV > III (D) II > III > IV > I

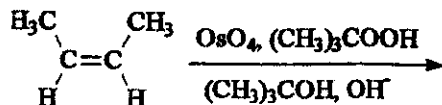
14. The proton NMR of 1,1-dibromoethane would appear as a:

- (A) downfield doublet and upfield quartet (B) downfield quartet and upfield doublet
(C) downfield doublet and upfield triplet (D) downfield triplet and upfield doublet

15. Select the strongest base in the following.

- (A) NaNH₂ (B) NaOCH₂CH₃ (C) CH₃Li (D) HC≡CNa

16. What is the product of the following reaction?



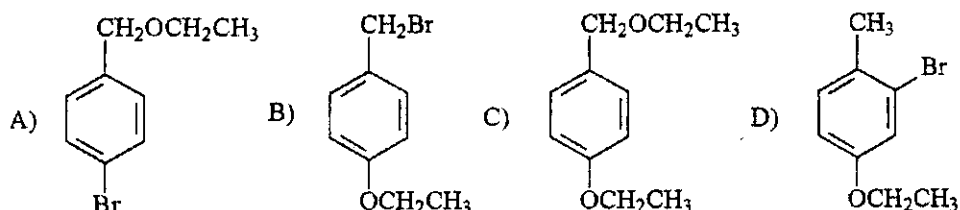
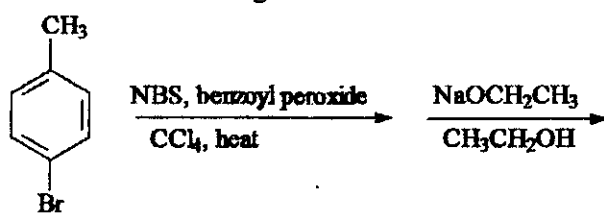
- (A) CH₃CH=O (B) *meso*-2,3-butanediol
(C) racemic (2R,3R) and (2S,3S)-2,3-butanediol (D) *cis*-2,3-epoxybutane

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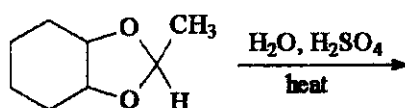
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17. What is the major product of the following reaction?



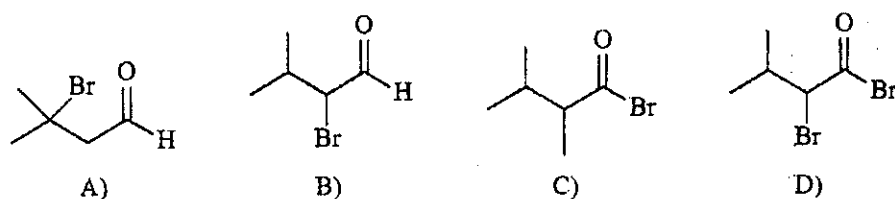
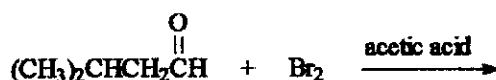
(A) A (B) B (C) C (D) D

18. What are the products of the following reaction?



(A) cyclohexanone and ethanol (B) cyclohexanone and ethanal
 (C) 1,2-cyclohexanediol and ethanal (D) 1,2-cyclohexanediol and ethanol

19. What is the product of the reaction below?

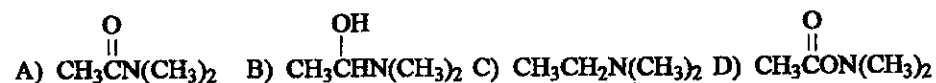
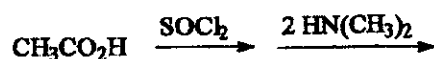


(A) A (B) B (C) C (D) D

20. Which of the following has the largest acid equilibrium constant, K_a ?

(A) benzoic acid (B) ortho-nitrobenzoic acid
 (C) para-methylbenzoic acid (para-toluic acid) (D) para-methoxybenzoic acid

21. What is the product of the following reaction sequence?

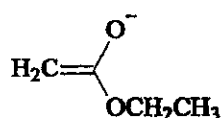


(A) A (B) B (C) C (D) D

(背面仍有題目, 請繼續作答)

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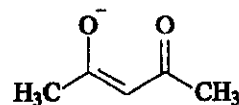
22. Rank the compounds below in order of decreasing basicity.



I



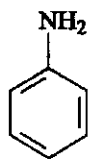
II



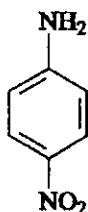
III

- (A) II > III > I (B) II > I > III (C) III > I > II (D) I > III > II

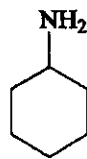
23. Rank the following three compounds in order of decreasing basicity.



I



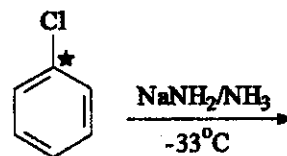
II



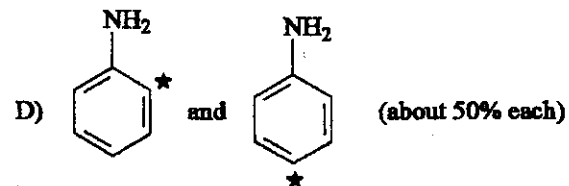
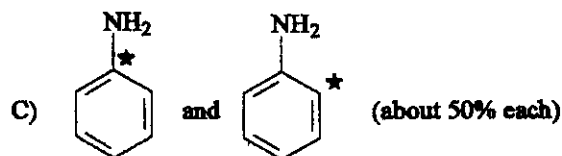
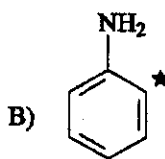
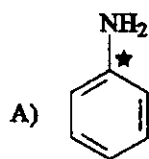
III

- (A) I > II > III (B) II > I > III (C) III > II > I (D) III > I > II

24. Carbon-14 labelled chlorobenzene is reacted with sodium amide in ammonia as shown below.



Which of the following depicts the carbon-14 label in the product(s)?



- (A) A (B) B (C) C (D) D

25. What is the purpose of electrophoresis?

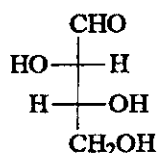
- (A) To neutralize amino acids. (B) To separate amino acids or proteins.
(C) To analyze the amino acid sequence in a protein (D) To synthesize amino acids or proteins.

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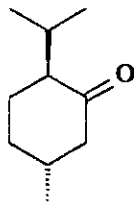
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26. What are the configurations of carbon atoms 2 and 3, respectively, of D-threose, shown below?

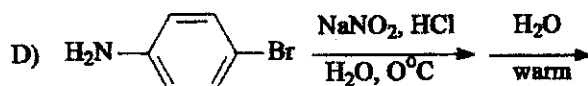
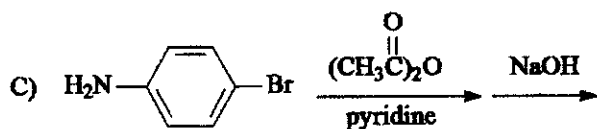
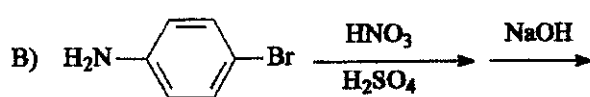
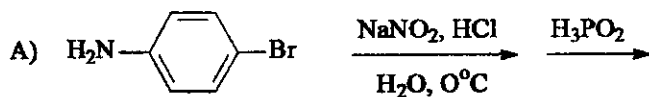


- (A) R,R (B) R,S (C) S,R (D) S,S

27. The structure of menthone is shown below. Methone is a:



- (A) monoterpene (B) sesquiterpene (C) diterpene (D) triterpene

28. Which reaction sequence below converts *para*-bromoaniline into *para*-bromophenol?

- (A) A (B) B (C) C (D) D

29. Which of the following are purines? I. adenine II. cytosine III. guanine IV. thymine

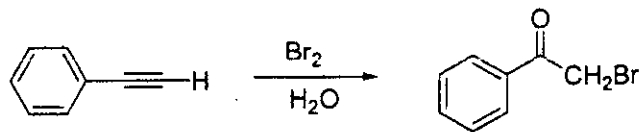
- (A) I and II (B) I and III (C) II and III (D) II and IV

30. Which of the following are addition polymers? I. polypropylene II. Teflon III. Nylon

- (A) only I (B) only II (C) only III (D) both I and II

二、簡答題 (共四十分)

1. 請利用 curved-arrow-push 寫出下列反應的反應機構 (8%)



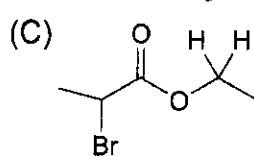
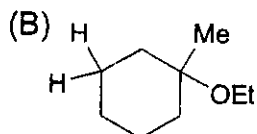
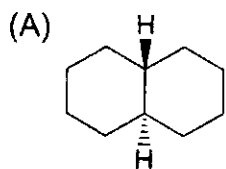
(背面仍有題目, 請繼續作答)

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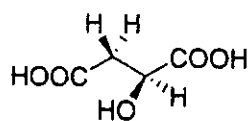
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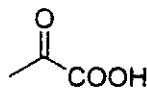
2. 下列各化合物中所列出的氫其關係為何 (unrelated, homotopic, enantiotopic or diastereotopic) (6%)



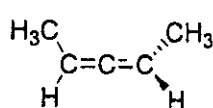
3. 此一大題共 12%, B 及 C 小題請選 R 或 S, 答錯時倒扣此一題分兩分, 題分扣完為止。



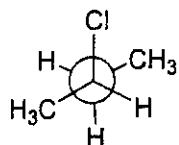
Malic acid



pyruvate



allene



Compound A

A. 將 Malic acid 分子上 pro-R 的 H 以 OH 置換, 此一化合物與其鏡面影像的關係為 (A) (3%)

B. 若酵素從 pyruvate 的 si face 利用 hydride (H) 將酮基還原成醇, 則新的非對稱中心組態為 (B) (3%)

C 此一 allene 的組態為 (C) (3%)

D. Compound A 含立體組態的 IUPAC 名稱為 (D) (3%)

4. Propose a structure for compound A, which has $M^+ = 86$ in its mass spectrum, an IR absorption at 3400 cm^{-1} , and the following ^{13}C NMR spectral data: (6%)Broadband decoupled ^{13}C NMR(δ): 30.2, 31.9, 61.8, 114.7, 138.4DEPT-90(δ): 138.4DEPT-135(δ): positive peaks at 138.4; negative peak at 30.2, 31.9, 61.8, 114.7

5. Propose structures for compounds that fit the following data:

(A) A ketone with $M^+ = 86$ and fragments at $m/z = 71$ and $m/z = 43$. (4%)(B) An alcohol with $M^+ = 88$ and fragments at $m/z = 73$, 70 and 59. (4%)