

# 國立臺北科技大學 110 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

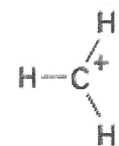
第 1 頁 共 2 頁

### 注意事項：

1. 本試題共兩大題，每大題 50 分，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。

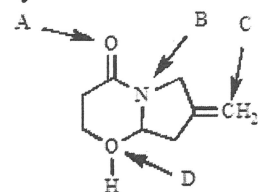
### 一 選擇題 (單選 每題 2 分共 50 分)

1. What hybridization do you expect the carbon atom of the following methyl carbocation to have?



(A)  $sp$  (B)  $sp^2$  (C)  $sp^3$  (D) The carbon atom is not hybridized.

2. What atom would have a formal charge in the right structure?

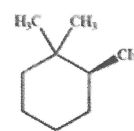


3. Which of the following describes the relationship between the following two structures?

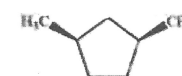


- (A) identical structures (B) resonance forms (C) constitutional isomers (D) different compounds with different compositions
4. Which of the following functional group classifications do **not** contain oxygen?
- (A) ether (B) thiol (C) aldehyde (D) amide (E) ester
5. How many constitutional isomers are there with the molecular formula  $\text{C}_6\text{H}_{14}$ ?
- (A) 3 (B) 4 (C) 5 (D) 6 (E) 8
6. Which of the following compounds can adopt a chair conformation in which there are no axial methyl groups? (A) 1,1-dimethylcyclohexane (B) *cis*-1,2-dimethylcyclohexane (C) *trans*-1,2-dimethylcyclohexane (D) *trans*-1,3-dimethylcyclohexane
7. Which of the following is the definition of a pair of enantiomers?
- (A) A pair of structures that are superimposable mirror images of one another
- (B) A pair of stereoisomers that are non-superimposable mirror images of one another
- (C) A pair of stereoisomers that are not mirror images of one another
- (D) A pair of stereoisomers that have equal specific rotations

8. Which of the following compounds is (are) achiral?



I



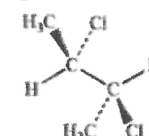
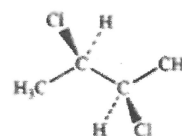
II



III

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

9. What is the relationship between the following pair of structures?



- (A) They are enantiomers. (B) They are diastereomers.  
(C) They are constitutional isomers.  
(D) They are identical with different conformations.

10. Alkene chemistry is dominated by what type of reaction?

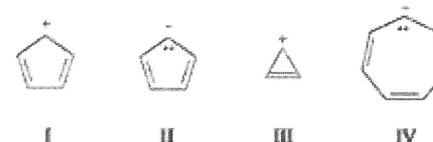
(A) substitution (B) electrophilic addition (C) nucleophilic addition (D) elimination

11. Which of the following alkenes exhibit *E-Z* isomerism?

I. 1-chloropropene II. 2-chloropropene III. 3-chloropropene

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

12. Which of the following ions are aromatic species?

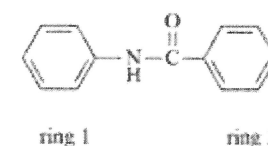


- (A) I and III (B) II and III  
(C) II and IV (D) III and IV

13. Rank the following compounds in order of decreasing reactivity to aromatic electrophilic bromination. I. benzene II. toluene III. benzoic acid IV. phenol

(A)  $\text{IV} > \text{II} > \text{I} > \text{III}$  (B)  $\text{IV} > \text{III} > \text{II} > \text{I}$  (C)  $\text{II} > \text{I} > \text{IV} > \text{III}$  (D)  $\text{II} > \text{III} > \text{IV} > \text{I}$

14. Where would the compound shown below undergo bromination with  $\text{Br}_2/\text{FeBr}_3$ ?

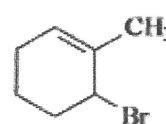


- (A) ortho/para position on ring 1 (B) meta position on ring 1  
(C) ortho/para position on ring 2 (D) meta position on ring 2

15. In the Friedel-Crafts alkylation of benzene, dialkylation is often a significant by-product. In the Friedel-Crafts acylation of benzene, diacylation is not a significant by-product. Which of the following is the primary reason for this difference?

- (A) Alkyl groups activate the ring to further substitution, acyl groups deactivate it.  
(B) Alkyl groups are less sterically hindered than acyl groups.  
(C) Acyl cations are more difficult to make with Lewis acids.  
(D) Unlike acyl cations, carbocations can undergo rearrangements.

16. What is the IUPAC name of the following compound?



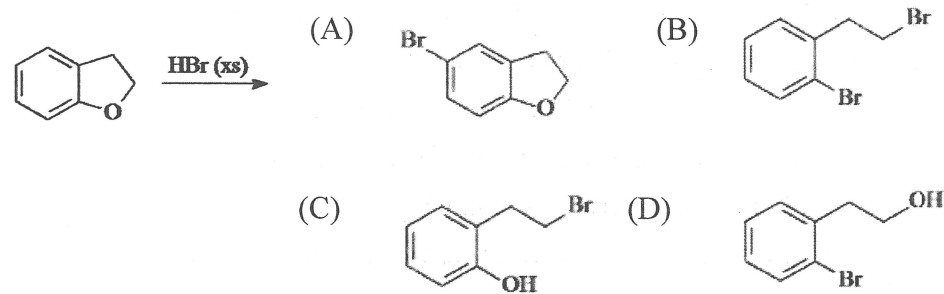
- (A) 3-bromo-2-methylcyclohexene  
(B) 1-bromo-2-methyl-2-cyclohexene  
(C) 6-bromo-1-methylcyclohexene  
(D) 2-bromo-1-methylcyclohexene

(注意：背面還有試題)

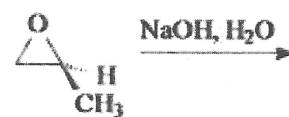
17. In the  $S_N2$  reaction, the "2" stands for (A) two reactants in the reaction. (B) two steps in the reaction. (C) two intermediates in the reaction. (D) bimolecular kinetics for the reaction.
18. Which of the following reacts the fastest by the  $S_N2$  mechanism?  
 (A)  $CH_3Br$  (B)  $CH_3CH_2Br$  (C)  $(CH_3)_2CHBr$  (D)  $(CH_3)_3CBr$
19. Identify the mechanistic pathways, respectively, for the products in the following reaction.



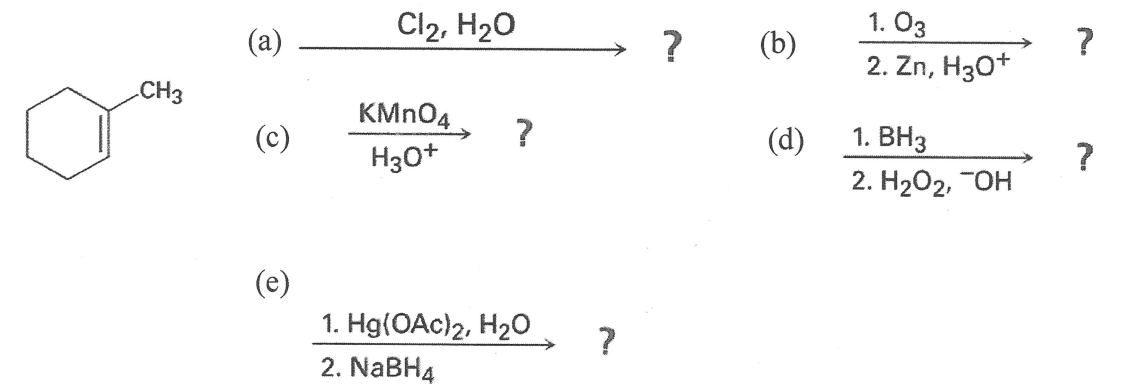
- (A)  $E1, S_N1$  (B)  $E1, S_N2$  (C)  $E2, S_N1$  (D)  $E2, S_N2$
20. Which one of the following compounds cannot undergo an  $E2$  reaction?  
 (A) 1-bromo-2,3-dimethylbutane (B) 2-bromo-2,3-dimethylbutane  
 (C) 1-bromo-3,3-dimethylbutane (D) 1-bromo-2,2-dimethylbutane
21. Which of the following sets of conditions most favors the  $E1$  mechanism?  
 (A) when the alkyl halide is tertiary and the base is a weak base  
 (B) when the alkyl halide is tertiary and the base is a strong base  
 (C) when the alkyl halide is primary or secondary and the base is a weak base  
 (D) when the alkyl halide is primary or secondary and the base is a strong base
22. Which of the following cannot be made by the reduction of a ketone or aldehyde with  $NaBH_4$  in methanol?  
 (A) 1-butanol (B) 2-butanol (C) 2-methyl-1-propanol (D) 2-methyl-2-propanol
23. As a reducing agent,  $NaBH_4$  donates a \_\_\_\_\_ to a ketone or aldehyde.  
 (A) proton (B) hydrogen atom (C) hydride ion (D) hydrogen molecule
24. What is the product of the following reaction?



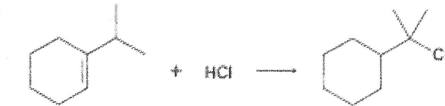
25. What is the product of the following reaction?  
 (A) (*S*)-1,2-propanediol (B) (*R*)-1,2-propanediol  
 (C) racemic mixture of 1,2-propanediol (D) 1,3-propanediol



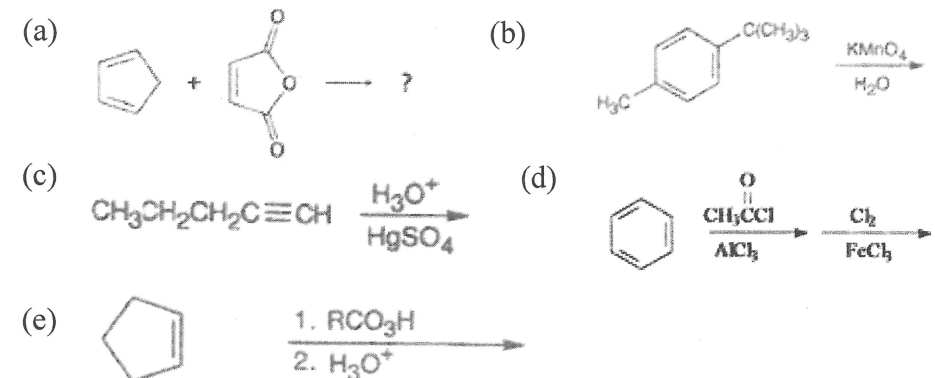
- 二 問答題 (共 50 分) (第 1, 3, 4 題的所有小題均寫出最終產物的化學結構即可)
1. Predict the products of the following reactions from 1-methylcyclohexene, showing both regiochemistry (orientation) and stereochemistry where appropriate: (每小題 3 分共 15 分)



2. Addition of  $HCl$  to 1-isopropylcyclohexene yields a rearranged product. Propose a mechanism, showing the structures of the intermediates and using curved arrows to indicate electron flow in each step. (5 分)



3. Predict the major product(s) of the following reactions (or reaction sequences): (每小題 3 分共 15 分)



4. Predict the major product(s) of each of the following reactions (or reaction sequences): (每小題 3 分共 15 分)

