

# 國立台北科技大學

## 九十三學年有機高分子研究所碩士在職專班入學考試

### 甲組：有機化學(含光譜分析)試題

填準考證號碼

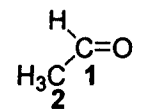
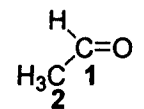
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第一頁 共三頁

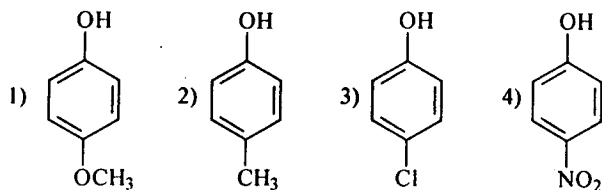
#### 注意事項

1. 本試題共 40 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

選擇題 (以下敘述正確者，每題 2.5 分，答錯倒扣 1 分；不答不計分，本大題共 100 分)

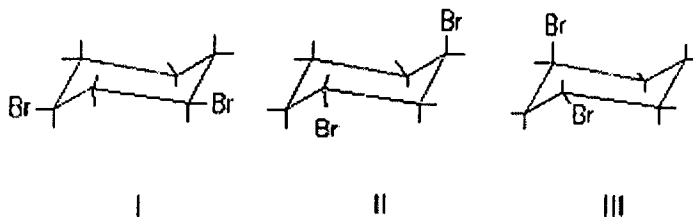
1. When the 1s orbitals of two hydrogen atoms combine to form a hydrogen molecule, how many molecular orbitals are formed?  
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
2.   
The carbon-carbon bond in  results from the overlap of which orbitals (in the order C<sub>1</sub>, C<sub>2</sub>)?  
(A) sp<sup>2</sup>-sp<sup>2</sup> (B) sp-sp<sup>3</sup> (C) sp<sup>2</sup>-sp<sup>2</sup> (D) sp<sup>2</sup>-sp<sup>3</sup> (E) sp<sup>3</sup>-sp<sup>3</sup>
3. How many constitutional isomers are possible with the formula C<sub>4</sub>H<sub>10</sub>O?  
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7
4. The C-O-C bond angle in diethyl ether is predicted to be approximately:  
(A) 90° (B) 105° (C) 110° (D) 120° (E) 180°
5. Which compound would have the highest boiling point?  
(A) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (B) CH<sub>3</sub>CH<sub>2</sub>OCH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (C) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH  
(D) CH<sub>3</sub>CH<sub>2</sub>OCH(CH<sub>3</sub>)<sub>2</sub> (E) CH<sub>3</sub>OCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>
6. According to the Lewis definition, a base is a(n):  
(A) Proton donor. (B) Electron pair donor. (C) Hydroxide ion donor.  
(D) Hydrogen ion donor. (E) Electron pair acceptor.
7. Which of the following is the strongest base?  
(A) RMgX (B) Mg(OH)X (C) RH (D) H<sub>2</sub>O

8. Which one of the following phenols is most acidic?



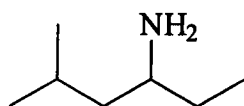
(A) 1 (B) 2 (C) 3 (D) 4

9. cis-1,3-Dibromocyclohexane is represented by structure(s):



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

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

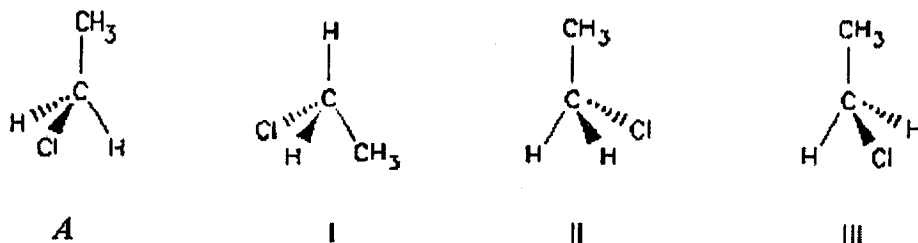


(A) 2-methyl-4-hexanamine (B) 2-methyl-4-aminohexane (C) 5-methyl-3-hexanamine  
(D) 5-methyl-3-aminohexane

11. Enantiomers are:

- (A) molecules that have a mirror image.  
(B) molecules that have at least one stereogenic center.  
(C) non-superposable molecules.  
(D) non-superposable constitutional isomers.  
(E) non-superposable molecules that are mirror images of each other.

12. Which of the following is the enantiomer of compound A:



(A) I (B) II (C) III (D) It does not have a non-superposable enantiomer. (E) Both II and III

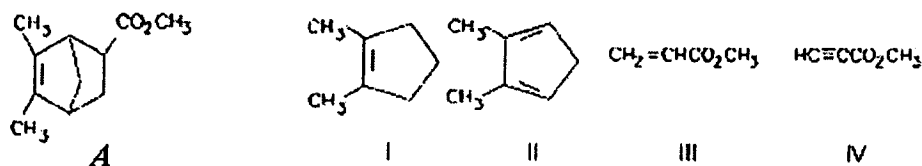
13. If a solution of a compound (30.0 g/100 mL of solution) has a measured rotation of  $+15^\circ$  in a 2 dm tube, the specific rotation is:

(A)  $+50^\circ$  (B)  $+25^\circ$  (C)  $+15^\circ$  (D)  $+7.5^\circ$  (E)  $+4.0^\circ$

27 Which of the reagents listed below would serve as the basis for a simple chemical test to distinguish between  $(\text{CH}_3)_3\text{COH}$  and  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$  ?

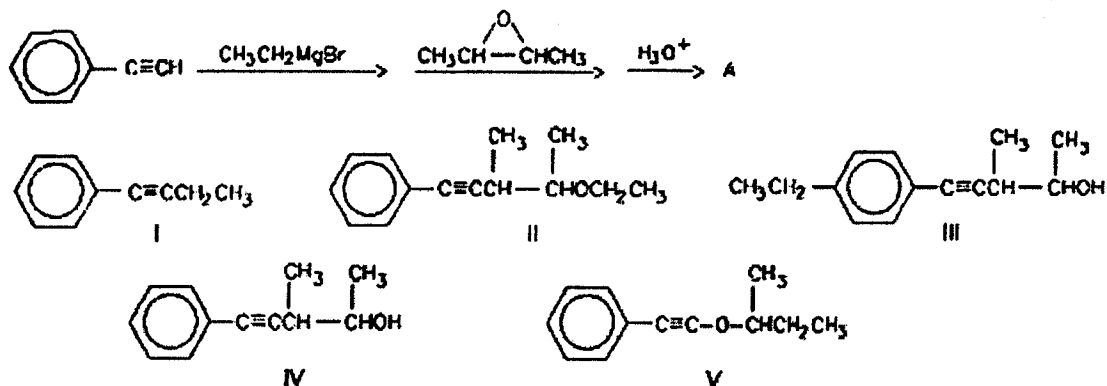
(A) NaH (B) NaOH/ $\text{H}_2\text{O}$  (C)  $\text{Br}_2$  in  $\text{CCl}_4$  (D) Cold conc.  $\text{H}_2\text{SO}_4$  (E)  $\text{CrO}_3$  in  $\text{H}_2\text{SO}_4$

28 Which compounds could be used in a Diels-Alder synthesis of compound A?



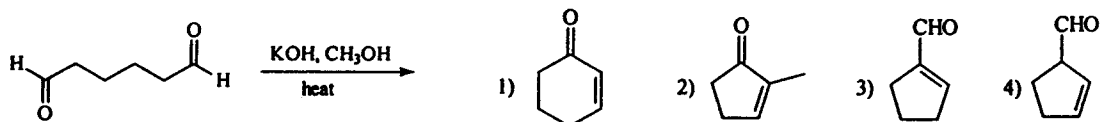
(A) I and III (B) I and IV (C) II and III (D) II and IV

29 What is the product, A, that would be obtained from the following reaction sequence?



(A) I (B) II (C) III (D) IV (E) V

30. What is the product of the following intramolecular aldol condensation reaction?



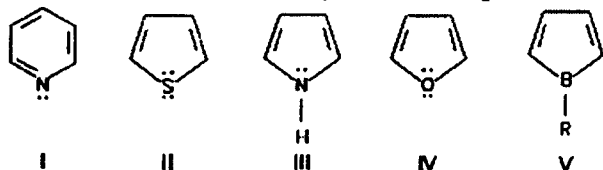
(A) 1 (B) 2 (C) 3 (D) 4

31. Which of the following would have the longest carbon-carbon bond?



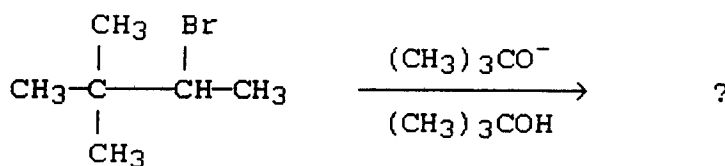
(A) I (B) II (C) III (D) IV (E) V

32. Which compound would you NOT expect to be aromatic?



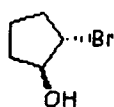
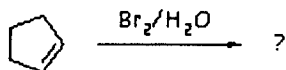
(A) I (B) II (C) III (D) IV (E) V

21. What is the major product of the reaction,

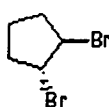


- (A)  $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)_2$  (B)  $(\text{CH}_3)_3\text{C}-\text{CH}=\text{CH}_2$  (C)  $(\text{CH}_3)_2\text{C}=\text{CHCH}_3$   
(D)  $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_3$  (E) None of these

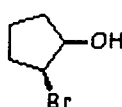
22. What would be the major product of the following reaction?



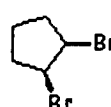
I



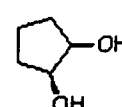
II



III



IV



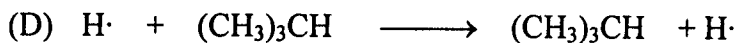
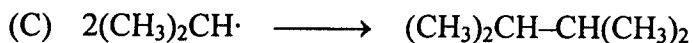
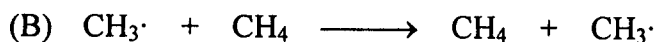
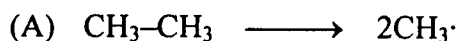
V

- (A) I (B) II (C) III (D) IV (E) V

23. How many compounds are possible from the addition of bromine to  $\text{CH}_2=\text{CHCH}_2\text{CH}_3$  (including stereoisomers)?

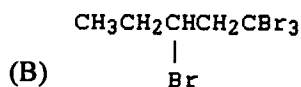
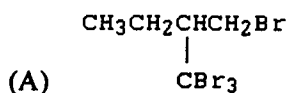
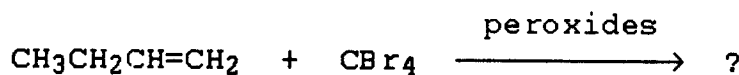
- (A) One (B) Two (C) Three (D) Four (E) Five

24. Which of the reactions listed below would be exothermic?



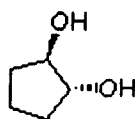
- (E) None of the above

25. What is the product of the reaction



- (C)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCBr}_3$  (D)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CBr}_3$  (E) No reaction occurs.

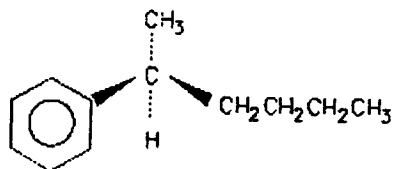
- 26.



is properly named:

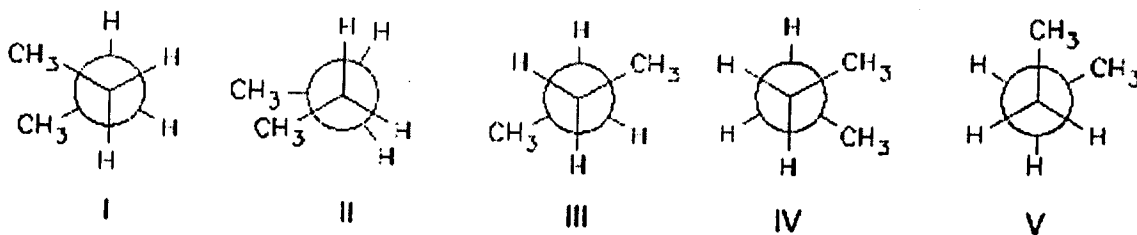
- (A) cis-1,2-Cyclopentanediol (B) meso-1,2-Cyclopentanediol  
(C) (1R,2R)-1,2-Cyclopentanediol (D) (1R,2S)-1,2-Cyclopentanediol  
(E) (1S,2S)-1,2-Cyclopentanediol

14. The following compound is most precisely named:



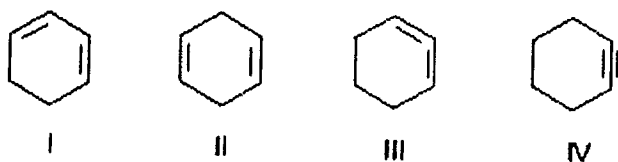
- (A) sec-Hexylbenzene (B) 2-Phenylhexane (C) (R)-2-Phenylhexane  
(D) (S)-2-Phenylhexane (E) Butylmethylphenylmethane

15. The least stable conformation of butane is:



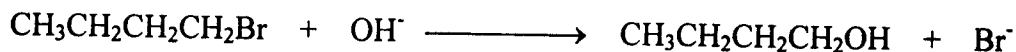
- (A) I (B) II (C) III (D) IV (E) V

16. Which of the following compounds would be the most stable?



- (A) I (B) II (C) III (D) IV (E) They are all of equal stability.

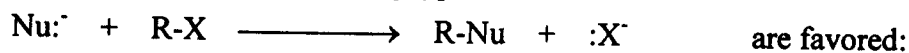
17. Consider the  $S_N2$  reaction of butyl bromide with  $\text{OH}^-$  ion.



Assuming no other changes, what effect on the rate would result from simultaneously doubling the concentrations of both butyl bromide and  $\text{OH}^-$  ion?

- (A) No effect. (B) It would double the rate. (C) It would triple the rate.  
(D) It would increase the rate four times. (E) It would increase the rate six times.

18.  $S_N1$  reactions of the following type,



by the use of tertiary substrates (as opposed to primary or secondary substrates). (B) by increasing the concentration of the nucleophile (C) by increasing the polarity of the solvent. (D) by use of a weak nucleophile. (E) by more than one of the above.

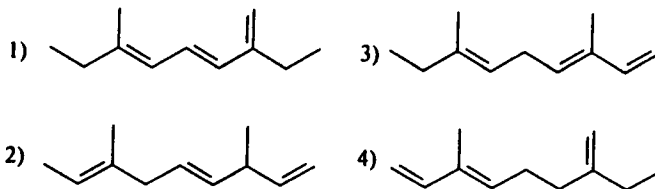
19. Your task is to convert 2-bromobutane to 1-butene in highest yield. Which reagents would you use?

- (A)  $\text{KOH}/\text{H}_2\text{O}$  (B)  $\text{KOH}/\text{CH}_3\text{OH}$  (C)  $\text{CH}_3\text{ONa}/\text{CH}_3\text{OH}$  (D)  $\text{CH}_3\text{CH}_2\text{ONa}/\text{CH}_3\text{CH}_2\text{OH}$   
(E)  $(\text{CH}_3)_3\text{COK}/(\text{CH}_3)_3\text{COH}$

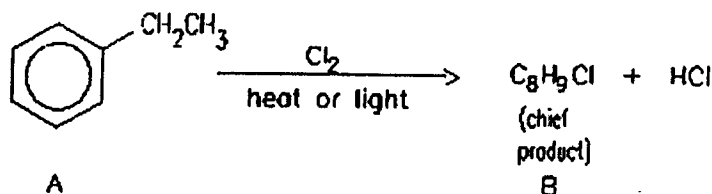
20. Which reagent or test could be used to distinguish between 1-bromohexane and hexane?

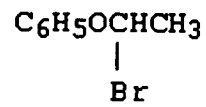
- (A)  $\text{Br}_2/\text{CCl}_4$  (B) IR examination (C) dilute  $\text{KMnO}_4$  (D) cold concd.  $\text{H}_2\text{SO}_4$  (E) None of these

33. Which dibromobenzene can yield only one mononitro derivative?  
 (A) o-Dibromobenzene (B) m-Dibromobenzene (C) p-Dibromobenzene (D) More than one of these (E) None of these
34. The IR stretching frequency occurs at the lowest frequency for which of these bonds?  
 (A) C-H (B) C-O (C) C-Br (D) C-N (E) C-F
35. An oxygen-containing compound which shows no IR absorption at  $1630-1780\text{ cm}^{-1}$  or at  $3200-3550\text{ cm}^{-1}$  is likely to be what type of compound?  
 (A) An alcohol (B) A carboxylic acid (C) An ether (D) A ketone (E) An aldehyde
36. How many  $^{13}\text{C}$  signals would 1,2-dimethylbenzene give?  
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
37. Which one of the following has a  $\lambda_{\text{max}}$  in its UV-visible spectrum with the longest wavelength?



- (A) 1 (B) 2 (C) 3 (D) 4
38. What feature would you expect to see in the  $^1\text{H}$  NMR spectrum of B after subjecting A to the following reaction?



- (A) There would be only 4 aromatic protons at low field.  
 (B) The signal for the protons on the benzylic carbon would be a doublet.  
 (C) The signal for the methyl protons would be a triplet.  
 (D) The signal for the methyl protons would be a doublet.  
 (E) The signal for the methyl protons would integrate for only 2 hydrogens.
39. A compound with the molecular formula  $\text{C}_8\text{H}_9\text{BrO}$  gave the following  $^1\text{H}$  NMR spectrum: triplet,  $\delta$  1.4, quartet,  $\delta$  3.9, multiplet,  $\delta$  7.0 (4H)  
 There was no evidence of an -OH band in the IR spectrum. A possible structure for the compound is:  
 (A)  $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_2\text{Br}$  (B)  $p\text{-CH}_3\text{C}_6\text{H}_4\text{OCH}_2\text{Br}$  (C)  $p\text{-BrC}_6\text{H}_4\text{OCH}_2\text{CH}_3$   
 (D)  (E)  $p\text{-CH}_3\text{OC}_6\text{H}_4\text{CH}_2\text{Br}$
40. What is the molecular formula of this compound?

| $m/z$           | intensity |
|-----------------|-----------|
| 84 $\text{M}^+$ | 10.00     |
| 85              | 0.56      |
| 86              | 0.04      |

- (A)  $\text{C}_5\text{H}_{10}\text{O}$  (B)  $\text{C}_5\text{H}_8\text{O}$  (C)  $\text{C}_5\text{H}_{24}$  (D)  $\text{C}_6\text{H}_{12}$  (E)  $\text{C}_4\text{H}_6\text{O}_2$