

題號： 60

國立臺灣大學 110 學年度碩士班招生考試試題

科目： 有機化學(A)

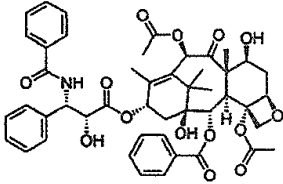
題號： 60

節次： 7

共 4 頁之第 1 頁

單選題： 第 1-25 題 (每題 3 分，共 75 分，請依題號順序於選擇題作答區內作答)

1. How many chiral centers can be found in the structure of Taxol drawn below?



(A) 10 (B) 11 (C) 12 (D) 13

2. How many of the following statements is/are correct?

- (I) Gauche form is the most stable conformer of butane.
- (II) In cyclopropane, the maximum electron density between two carbon atoms corresponds to the internuclear axis.
- (III) According to Baeyer strain theory, cyclopentane has greater angle strain than cyclohexane.

(A) 0 (B) 1 (C) 2 (D) 3

3. How many of the following statements is/are correct?

- (I) The *cis* form of 1,3-dimethyl cyclohexane is more stable than the *trans* form.
- (II) In cyclohexane, the boat form conformer is more stable than the twist-boat form.
- (III) The 1,3-diaxial interaction in cyclohexane is mainly resulted from the torsional strain.

(A) 0 (B) 1 (C) 2 (D) 3

4. How many of the following statements is/are correct?

- (I) Meso-tartaric acid can rotate plane polarized light.
- (II) Nitrogen and sulfur atoms can be chiral centers.
- (III) A racemic mixture can't rotate plane polarized light.

(A) 0 (B) 1 (C) 2 (D) 3

5. How many of the following statements is/are correct?

- (I) Normally, aryl and vinyl halides are good substrates for  $S_N2$  reactions.
- (II)  $S_N2$  and  $S_N1$  reactions prefer protic and aprotic solvents, respectively.
- (III) Both  $E1$  and  $S_N1$  reactions produce carbocations in their reaction pathways.

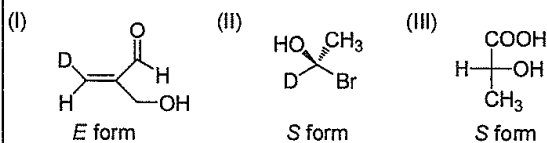
(A) 0 (B) 1 (C) 2 (D) 3

6. How many of the following statements about 1-bromo-2-methyl cyclohexane is/are correct?

- (I) The *cis* form is more stable than the *trans* form.
- (II) Using base to eliminate the *trans* form should afford lots of Hoffman product.
- (III) Using base to eliminate the *cis* form should majorly afford Zaitsev (or Saytzeff) product.

(A) 0 (B) 1 (C) 2 (D) 3

7. How many of the following assignments is/are correct?



(A) 0 (B) 1 (C) 2 (D) 3

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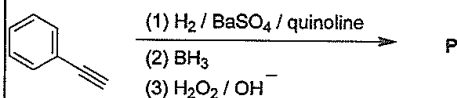
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8. Which of the listed molecules has the highest frequency of the HOMO  $\rightarrow$  LUMO transition?

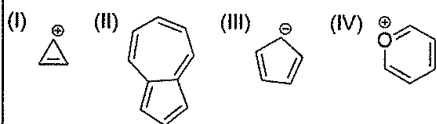
- (A)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$  (B)  $\text{H}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{H}$  (C)  $\text{H}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{H}$   
 (D)  $\text{R}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{R}$  (R = phenyl)

9. About the following transformation, how many of the statements is/are correct?



- (I) Step (1) is a homogeneous catalytic reaction.  
 (II) The major product in step (2) has a boron atom attached to the benzylic position.  
 (III) Product P is a primary alcohol.  
 (A) 0 (B) 1 (C) 2 (D) 3

10. How many of the following compounds is/are aromatic?



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

11. How many of the following compounds is/are more basic than triethylamine?

- (I) pyridine (II) pyrrole (III) sodium methoxide (IV) lithium diisopropylamide  
 (A) 1 (B) 2 (C) 3 (D) 4

12. How many of the following reagents should transform cyclohexene to alcohol after normal workup?

- (I)  $\text{BH}_3$  then  $\text{H}_2\text{O}_2/\text{OH}^-$  (II)  $\text{OsO}_4$  then  $\text{NaHSO}_3$  (III)  $\text{Hg}(\text{OAc})_2$  then  $\text{NaBH}_4$  (IV) MCPBA then  $\text{H}_2\text{O}/\text{H}^+$   
 (A) 1 (B) 2 (C) 3 (D) 4

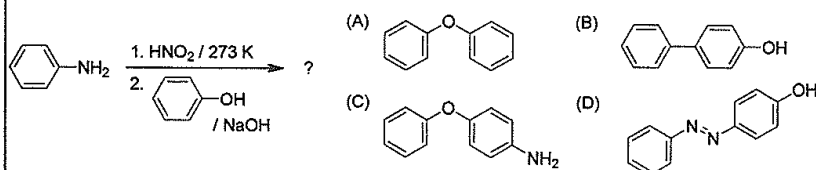
13. How many of the following statements about radicals is/are correct?

- (I) Radicals can be generated efficiently in the presence of BHT.  
 (II) ABIN is a common radical initiator.  
 (III) In the step of radical propagation, both heat and the number of free radicals increase.  
 (A) 0 (B) 1 (C) 2 (D) 3

14. Which of the following compounds would not undergo racemization in base?

- (A) (S)-3-methyl-4-heptanone (B) (S)-3-ethyl-2-heptanone (C) (R)-4-ethyl-2-heptanone  
 (D) (R)-2,4-dimethyl-3-heptanone

15. Which is the major product of the following reaction?

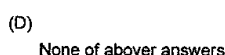
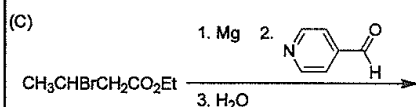
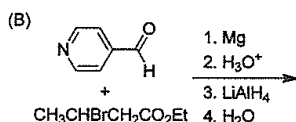
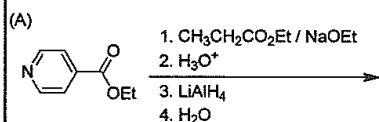
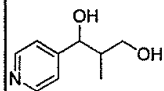


16. Among the following solvents, which is the best for the reaction of 1-bromohexane with sodium azide?

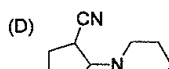
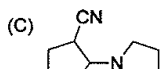
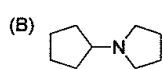
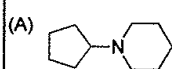
- (A) dimethylsulfoxide (B) methanol (C) hexane (D) toluene

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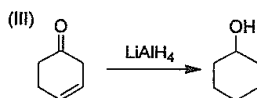
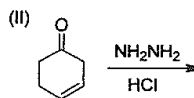
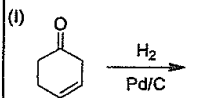
17. Which of the following transformations might be used to synthesize the following substance?



18. What is most likely to be the final product when cyclopentene is subjected to the following reaction sequence: (I)  $\text{H}^+/\text{H}_2\text{O}$ ; (II) PCC; (III) piperidine; (IV)  $\text{NaBH}_3\text{CN}$ ?



19. How many of the following transformations is/are likely to be practical?



(A) 0 (B) 1 (C) 2 (D) 3

20. How many of the following statements regarding bromination ( $\text{Br}_2/\text{FeBr}_3$ ) of toluene is/are correct?

(A) Reaction begins with the complexation of bromine with the  $\text{FeBr}_3$

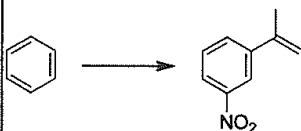
(B) Formation of  $\text{Br}^+$  ion is not the rate determining step

(C) Addition of  $\text{Br}^+$  to toluene to form the arenium ion is the rate determining step

(D) 4-Bromotoluene is formed by losing a hydride from the arenium ion

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

21. How many of the following reaction sequences can properly achieve the transformation below?



(I) (i)  $\text{CH}_3\text{COCl}/\text{AlCl}_3$ ; (ii)  $\text{HNO}_3/\text{H}_2\text{SO}_4$ ; (iii)  $\text{CH}_3\text{MgBr}$ ; (iv)  $\text{H}_3\text{O}^+/\text{heat}$

(II) (i)  $\text{CH}_3\text{COCl}/\text{AlCl}_3$ ; (ii)  $\text{CH}_3\text{MgBr}$ ,  $\text{Et}_2\text{O}$ ; (iii)  $\text{H}_3\text{O}^+/\text{heat}$ ; (iv)  $\text{HNO}_3/\text{H}_2\text{SO}_4$

(III) (i)  $\text{CH}_3\text{COCl}/\text{AlCl}_3$ ; (ii)  $\text{HNO}_3/\text{H}_2\text{SO}_4$ ; (iii)  $\text{CH}_2=\text{PPh}_3$

(A) 0 (B) 1 (C) 2 (D) 3

22. Which of the following is not prominent in the mass spectrum of 2-methyl-2-butanol?

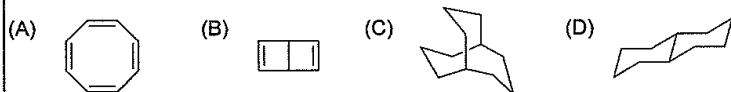
(A) M-12 (B) M-15 (C) M-18 (D) M-29

23. Which of the following compound is the most reactive toward nucleophilic aromatic substitution?

(A) 4-fluoro-1,2-dinitrobenzene (B) 1-fluoro-2,4-dinitrobenzene (C) 2-fluoronitrobenzene (D) no reaction for all above answers

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24. Which of the following molecules would not be considered a bicyclic molecule?



25. Calculate the degrees of unsaturation for a molecule with the molecular formula  $C_9H_{12}ClNO_3$ .

(A) 4 (B) 5 (C) 6 (D) 7

問答題： 第 16-20 題 (共 25 分，請依題號順序於非選擇題作答區內作答)

1. Assign the C-H bond dissociation energy (kcal/mole) listed below to the three different radicals. Explain the size of the other two values relative to that for the H-CH<sub>3</sub> bond. (5 分)

H-R BDE (Kcal/mol) : 88.8; 105.0; 110.7

•R : •CH<sub>3</sub> / •CH=CH<sub>2</sub> / •CH<sub>2</sub>-CH=CH<sub>2</sub>

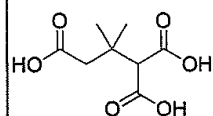
2. Determine the structure compound C<sub>10</sub>H<sub>12</sub>O<sub>2</sub> based on the following spectroscopic data. (5 分)

<sup>13</sup>C NMR (δ, ppm): 11, 22, 67, 128, 130, 131, 133, 167;

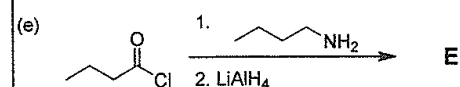
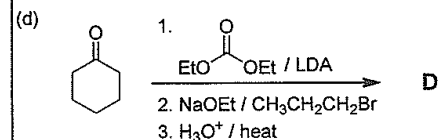
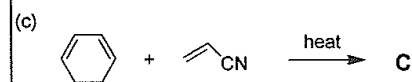
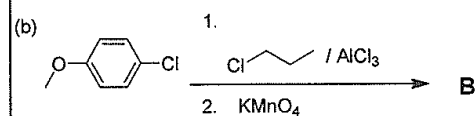
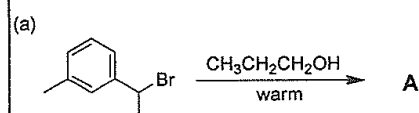
<sup>1</sup>H NMR (δ, ppm): 1.02 (triplet, 3H), 1.80 (sextet, 2H), 4.17 (triplet, 2H), 7.12-7.27 (multiplet, 3H), 7.96-8.08 (multiplet, 2H);

IR (selected peaks; cm<sup>-1</sup>): 3040, 2950, 1730, 1550, 1450, 1280, 1100, 700.

3. The following compound release CO<sub>2</sub> and H<sub>2</sub>O after being heated at 230 °C. Draw the structure of the most possible reaction product. (5 分)



4. Give the major product in line-angle structure of each of the following reactions: (10 分)



試題隨卷繳回