

國立成功大學  
110學年度碩士班招生考試試題

編 號：270

系 所：生物化學暨分子生物學研究所

科 目：有機化學

日 期：0203

節 次：第 2 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

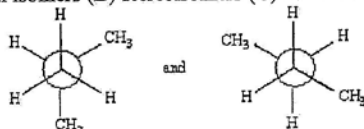
一、選擇題：(單選，每題 2 分，共 28 分)

1. How many constitutional isomers exist for a cycloalkane with the formula  $C_6H_{12}$ ?

(A) 5 (B) 6 (C) 7 (D) 8 (E) 9.

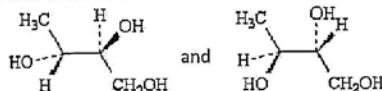
2. What is the relationship between the following pair of compounds?

(A) conformational isomers (B) stereoisomers (C) constitutional isomers (D) identical (E) none of above.



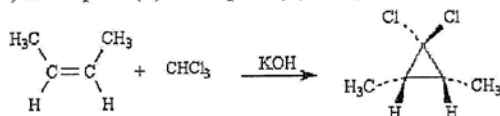
3. Which of the following terms best describes or refers to the molecules which contain a plane of symmetry and chirality centers, but are achiral? (A) racemates (B) meso compounds (C) diastereomers (D) enantiomers (E) none of above.

4. What is the relationship between the following pair of the compounds? (A) enantiomers (B) diastereomers (C) identical (D) none of above.

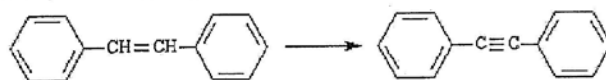


5. Which is the degree of unsaturation in  $C_{16}H_{13}N_2OCl$  (diazepam)? (A) 9 (B) 10 (C) 11 (D) 12 (E) 13.

6. What is the role of dichlorocarbene involved in the following formation of dichlorocyclopropane?  
(A) Lewis base (B) nucleophile (C) electrophile (D) catalyst.

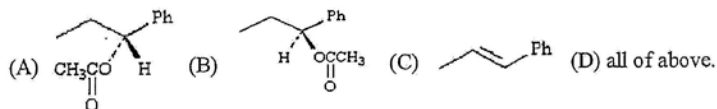
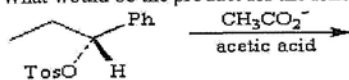


7. Which of the following reagents and reaction conditions can be used for the following chemical transformation?  
(A) 1.  $Br_2$ ,  $CCl_4$ ; 2.  $NaNH_2$ ,  $NH_3$  (B)  $H_2SO_4$ ,  $H_2O$ ,  $HgSO_4$  (C)  $Li/NH_3$  (D) 1.  $BH_3$ , THF; 2.  $H_2O_2$  (E) 1.  $HCl$ ; 2.  $NaNH_2$ ,  $NH_3$ .

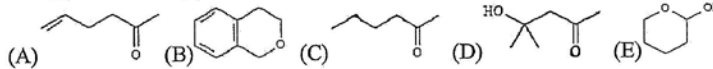
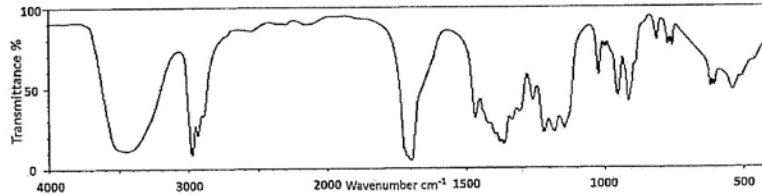


8. Which of the following items can serve as the best solvent for an  $S_N2$  reaction? (A) ethanol (B) water (C) chloroform (D) hexamethylphosphoramide (E) all of above.

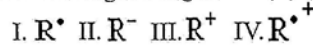
9. What would be the product for the following reaction condition?



10. Which of the following compounds can give the IR spectrum shown below?

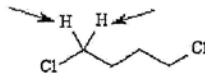


11. Which of the following organic fragments can be detected by a mass spectrometer by giving a signal? R represents an organic fragment. (A) I, III (B) II, III (C) I, II (D) III, IV (E) I, IV.



12. Which of the following statements about NMR is false? (A) NMR spectroscopy provides information about a molecule's carbon-hydrogen framework (B) For a nucleus to exhibit the NMR phenomenon, it must be magnetic. Magnetic nuclei include all nuclei with odd numbers of protons (C) When looking at an NMR chart, the right-hand part of the chart is the high-field or upfield side (D) The NMR charts are calibrated using an arbitrary scale that is divided into delta units (E) none of above.

13. Which of the following items describes the relationship between the indicated sets of protons? (A) homotopic (B) enantiotopic (C) diastereotopic (D) none of above.



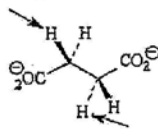
14. Which of the following reagents and reaction conditions is most appropriate for the following chemical transformation? (A)  $LiAlH_4$ , THF (B)  $NaBH_4$ , ethanol (C) 1. DIBALH, toluene; 2.  $H_3O^+$  (D)  $H_2/Pd$  (E) all of above.



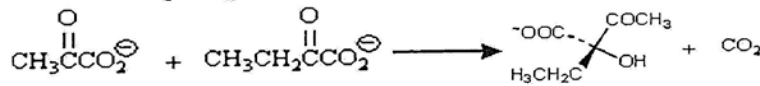
二、簡答題：(每題 3 分，共 54 分)

1. Draw the chemical structure for *trans*-1-*tert*-butyl-4-ethylcyclohexane.

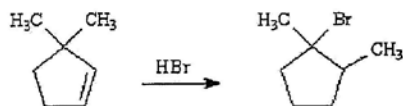
2. Identify the indicated hydrogens in the following molecule as *pro-R* or *pro-S*.



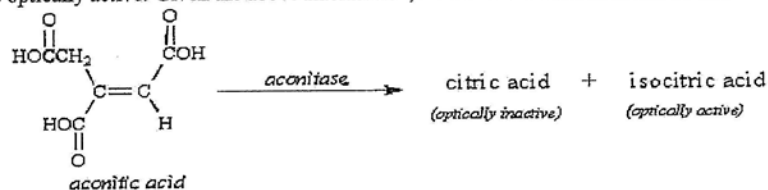
3. In the presence of thiamine pyrophosphate, acetoacetate synthase catalyzes the addition of pyruvate to  $\beta$ -ketobutyrate to yield  $\alpha$ -aceto- $\alpha$ -hydroxybutyrate. In terms of prochirality, which face of  $\beta$ -ketobutyrate does the addition take place upon?



4. Add curved arrows to the following reaction to indicate the flow of electrons in a stepwise mechanism.



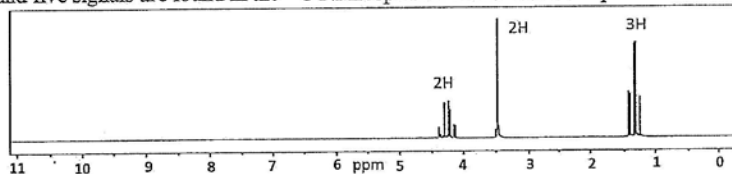
5. The hydration of the alkene functional group of aconitic acid can give two products, citric acid and isocitric acid as shown, by the catalysis of the enzyme aconitase. Citric acid is not optically active, whereas isocitric acid is optically active. Given the above information, draw the chemical structure of citric acid.



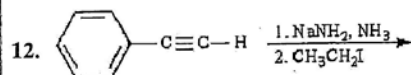
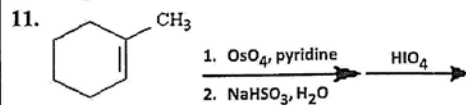
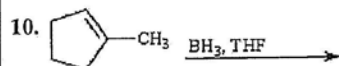
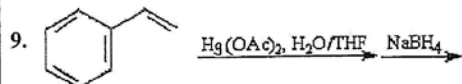
6. The *trans*-dihalide is formed when cyclohexene reacts with chlorine in carbon tetrachloride. The stereochemistry of the product can be explained by the intermediacy of a chloronium. Draw the chemical structure of the chloronium ion intermediate.

7. Draw the chemical structure for 3,10-dimethyl-6-*sec*-butylcyclodecyne.

8. Propose the chemical structure for a compound with the following spectroscopic data: The mass spectrum gives a molecular ion at  $m/z = 113$ , the IR spectrum shows characteristic absorptions at 2270 and 1735  $\text{cm}^{-1}$ , and five signals are found in the  $^{13}\text{C}$  NMR spectrum. The  $^1\text{H}$  NMR spectrum is shown below.



Predict the major organic reaction product(s) for each of the following reactions below (第 9-18 題).



13.

14.

15.

16.

17.

18.

三、問答題：(每題 6 分，共 18 分)

- Give and explain major differences between an organic reaction taking place in flask in the laboratory as compared to the reaction occurring in a biological living system?
- Methanol can be generated by reaction of bromomethane with sodium hydroxide in water. Answer the following questions:
  - What would happen to the rate of methanol formation if sodium iodide is added to the reaction mixture? What would be the functional role of sodium iodide?
  - What would happen to the reaction if sodium chloride is added instead of sodium iodide?
  - Provide a reaction mechanism or pathway to explain your answers to (a).
- For the following two compounds Y and Z, answer the following questions:
  - Which of the compounds Y and Z is more acidic?
  - Give a rational explanation for the answer to (a) by providing detailed mechanism.