

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。


國立清華大學 114 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

科目代碼：3005

考試科目：有機化學

— 作答注意事項 —

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「 由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

國立清華大學 114 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

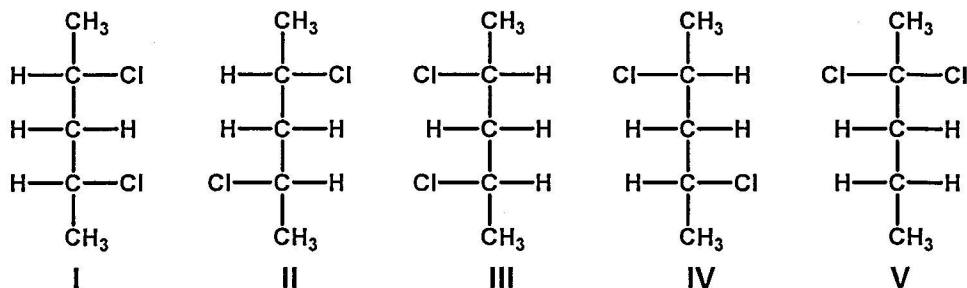
考試科目 (3005)：有機化學

共 7 頁，第 1 頁

*請在【答案卡】作答

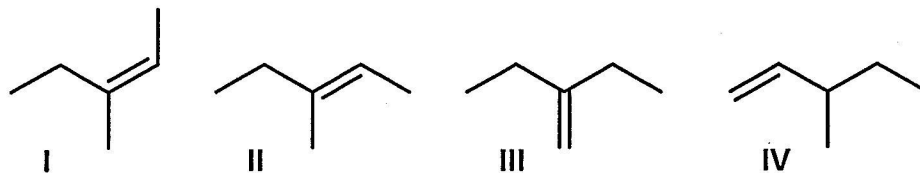
一、單選題 (每題 4 分共 100 分)

1. List all pairs of enantiomers.



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

2. Which of the following alkenes produce(s) 3-bromo-3-methylpentane as the major product when HBr is added?



- (A) I and II (B) III (C) I, II, and III (D) all of them (E) none of them

3. Which of the following statements is TRUE?

- (A) all chiral molecules possess a plane of symmetry.
 (B) all achiral molecules are meso.
 (C) all molecules which possess a single chirality center of the *S* configuration are levorotatory.
 (D) a mixture of achiral compounds will be optically inactive.
 (E) all molecules which possess two or more chirality centers will be chiral.

國立清華大學 114 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

考試科目 (3005)：有機化學

共 7 頁，第 2 頁

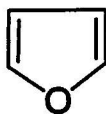
*請在【答案卡】作答

4. For an endergonic reaction step, the Hammond postulate states that _____.
(A) the transition state of the step resembles the reactants of the step.
(B) the transition state is more similar in structure to the products than to the reactants.
(C) the step is rate-determining since it has the smallest E_a .
(D) the reaction containing this step is overall first order.
(E) the transition state is precisely symmetric with bond-breaking and bond-forming occurring to the same extent.

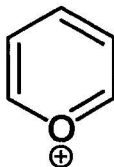
5. Which of the following structures is an antiaromatic compound?



I



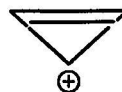
II



III



IV



V

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

6. Which of the followings is the weakest base?

- (A) phenolate ion
(B) ethoxide ion
(C) hydroxide ion
(D) acetate ion
(E) methoxide ion

7. For S_N1 reactions, which of the following statement is TRUE?

- (A) complete inversion of configuration occurs.
(B) these reactions are favored by nonpolar solvents.
(C) these reactions are favored by polar solvents.
(D) reaction rates depend only on the concentration of the nucleophile.
(E) the mechanism is a one-step back attack.

國立清華大學 114 學年度碩士班考試入學試題

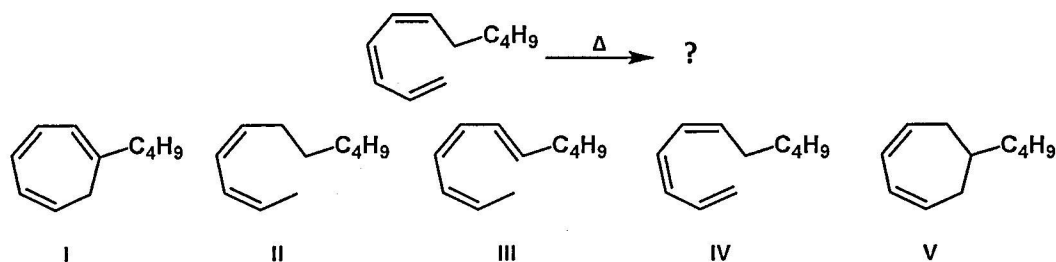
系所班組別：分析與環境科學研究所

考試科目 (3005)：有機化學

共 7 頁，第 3 頁

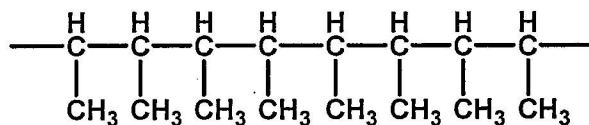
*請在【答案卡】作答

8. What is the product of the following 1,7-hydrogen shift reaction?



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

9. Determine the monomer structure from which the following polymer is made.



- (A) CH_3CH_3
 (B) $\text{CH}_2=\text{CH}_2$
 (C) $\text{CH}_3\text{CH}=\text{CH}_2$
 (D) $\text{CH}_2=\text{CHCH}=\text{CH}_2$
 (E) $\text{CH}_3\text{CH}=\text{CHCH}_3$

10. What is the product formed when a diisocyanate reacts with a diol?

- (A) an epoxy resin
 (B) a polyester
 (C) a polycarbonate
 (D) a polyamide
 (E) a polyurethane

國立清華大學 114 學年度碩士班考試入學試題

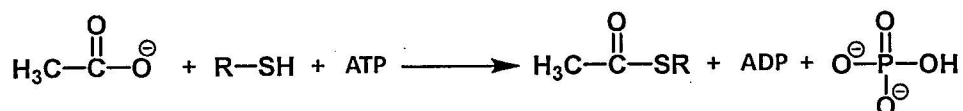
系所班組別：分析與環境科學研究所

考試科目（3005）：有機化學

共 7 頁，第 4 頁

*請在【答案卡】作答

11. What is the first step in the mechanism of the reaction shown below?



- (A) carboxylate ion attacks the thiol.
- (B) carboxylate ion attacks the α -phosphorus of ATP.
- (C) carboxylate ion attacks the γ -phosphorus of ATP.
- (D) thiol molecule attacks the β -phosphorus of ATP.
- (E) thiol molecule attacks the acyl group.

12. Regarding retroviruses, which of the following statements is **NOT TRUE**?

- (A) the genetic information is contained in RNA.
- (B) the genetic information flows from DNA to RNA.
- (C) drugs have been designed to interfere with the synthesis of DNA by retroviruses.
- (D) AZT is a design drug that was synthesized to combat the HIV retrovirus.
- (E) The retrovirus uses the sequence of bases in RNA as a template to synthesize DNA which enters and infects the host cell.

13. What is the composition of a ribosome?

- (A) 40% protein, 60% rRNA
- (B) 60% protein, 40% tRNA
- (C) 40% protein, 60% tRNA
- (D) 40% protein, 60% mRNA
- (E) 100% protein, 0% rRNA

國立清華大學 114 學年度碩士班考試入學試題

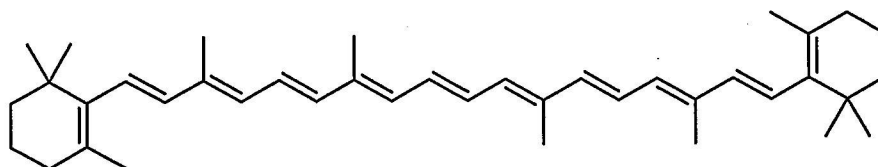
系所班組別：分析與環境科學研究所

考試科目 (3005)：有機化學

共 7 頁，第 5 頁

*請在【答案卡】作答

14. How many isoprene units are present in β -carotene?



- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

15. How many ATP molecules are produced in glycolysis when one glucose molecule is converted into two pyruvate molecules?

- (A) 2 (B) 3 (C) 4 (D) 6 (E) 12

16. Which of the following vitamins is the only lipid-soluble vitamin that functions as a coenzyme?

- (A) vitamin A
(B) vitamin D
(C) vitamin B₁
(D) vitamin C
(E) vitamin K

17. Regarding coenzymes, which of the following statements is **NOT TRUE**?

- (A) coenzymes catalyze chemical reactions similar to enzymes.
(B) coenzymes may function as oxidizing and reducing agents.
(C) coenzymes play a variety of chemical roles exactly like those played by the amino acid side chains of enzymes.
(D) coenzymes may function as nucleophiles or strong bases needed in a reaction.
(E) coenzymes may function as activators needed in a reaction.

國立清華大學 114 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

考試科目 (3005)：有機化學

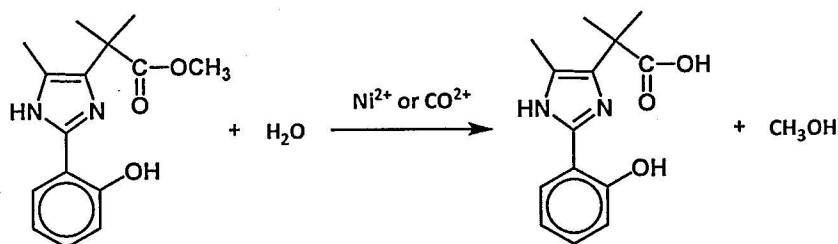
共 7 頁，第 6 頁

*請在【答案卡】作答

18. Which amino acid in an enzyme has a side chain that can react with the substrate to form an imine?

- (A) lysine (B) methionine (C) phenylalanine (D) serine (E) aspartic acid

19. What is the main purpose for using metal-ions as catalysts in the following hydrolysis reaction?



- (A) increases the rate by making water a stronger base, thereby increasing its electrophilicity
(B) increases the rate by making water a stronger base, thereby increasing its nucleophilicity
(C) increases the rate by making water a stronger acid, thereby increasing its nucleophilicity
(D) increases the rate by making water a stronger acid, thereby increasing its electrophilicity
(E) increases the rate by making water a stronger acid, thereby decreasing its nucleophilicity

20. In peptide synthesis, what is the role of dicyclohexylcarbodiimide?

- (A) activates the carboxyl group of an amino acid
(B) protects the carboxyl group of an amino acid
(C) protects the amino group of an amino acid
(D) activates the amino group of an amino acid
(E) removes the protecting group on the N-terminal amino acid

國立清華大學 114 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

考試科目 (3005)：有機化學

共 7 頁，第 7 頁

*請在【答案卡】作答

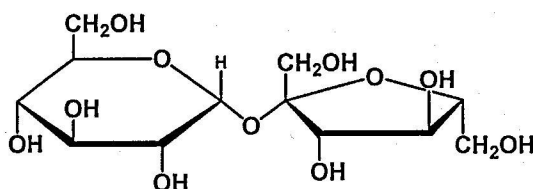
21. Which of the following amino acids will have the smallest retention factor (rf) when separated by normal-phase thin-layer chromatography?

- (A) serine (B) alanine (C) cysteine (D) aspartate (E) phenylalanine

22. Which of the following represents the general formula of a carbohydrate?

- (A) C_nH_{2n+2}
(B) C_nH_{2n}
(C) C_nH_{2n-2}
(D) $C_n(H_2O)_n$
(E) $C_n(HO)_n$

23. Give the common name for the following chemical structure.



- (A) lactose (B) fructose (C) sucrose (D) maltose (E) galactose

24. When a disulfide linkage is formed, the compound containing this new linkage has been _____.

- (A) hydrolyzed (B) dehydrated (C) electrolyzed (D) oxidized (E) reduced

25. Which of the following statements most accurately defines the term alkaloid?

- (A) heterocyclic natural products with a nitrogen as a heteroatom
(B) natural, cyclic hydrocarbons
(C) heterocyclic natural products with a sulfur as a heteroatom
(D) heterocyclic natural products with an oxygen as a heteroatom
(E) natural, cyclic hydrocarbons with alkyl groups