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 110 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 ：2905

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。

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 *請在【答案卡】作答

一、 單選題（每題 4 分共 100 分）

1. The simplest amino acid is

   (A) Alanine (B) Serine (C) Glycine (D) Valine

2. In a Merrifiled solid phase peptide synthesis, if there are 5 steps and each goes in 90% yield, what is the overall yield?

   (A) 18% (B) 45% (C) 59% (D) 90%

3. Esters and amides are the most easily made by nucleophilic acyl substitution reactions on:

   (A) alcohols (B) acide anhydrides (C) carboxylates (D) carboxylic acids (E) acid chlorides

4. An organic compound A is formed by the reaction of ethylmagnesium iodide with a substance B, followed by the treatment with dilute aqueous acid. Compared A does not react with pyridinium chlorochromate in dichloromethane. Which one the following is a possible candidate for B?

   (A) CH_3CHO (B) CH_3CH_2OH (C) $CH_3CH_2COCH_3$ (D) HCO_2CH_3

5. Vulcanization is a process to strengthen natural rubber by crosslinking polymer chains with what element?

   (A) sodium (B) titanium (C) sulfer (D) phosphorus (E) aluminum

6. Epoxide undergoes ring-opening reaction with water to generate

   (A) glycol (B) glyoxal (C) ester alcohol (D) none of above

7. For isobutanol:

   (A) it is a primary alcohol

   (B) it is a constitutional isomer of cyclobutanol

   (C) it shows a characteristics absorption at 1720 cm^{-1} in IR spectrum

   (D) it shows four carbon signals in the ^{13}C NMR spectrum.

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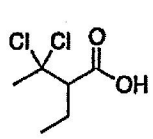
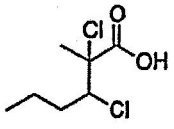
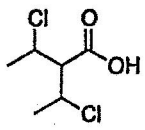
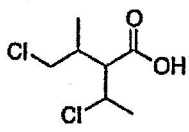
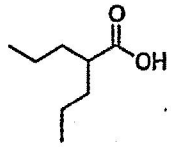
8. Which one of following structures has the lowest pKa?

(a) 

(b) 

(c) 

(d) 

(e) 

9. Which description about the frontier molecular orbital theory is False?

(A) HOMO is an acronym for highest occupied molecular orbital.

(B) Antibonding molecular orbitals are higher in energy than the isolated atomic orbitals from which they made.

(C) The LUMO of 1,3-butadiene has one node.

(D) The HOMO of allyl anion has one node.

(E) The thermal [2+2] cycloaddition of two ethylenes to give cylobutane is a symmetry-forbidden reaction.

10. Which of following addition reactions of alkenes occur specifically in an anti- fashion:

(A) Dihydroxylation using OsO_4, H_2O_2

(B) Addition of Br_2

(C) Hydroboration-oxidation

(D) Hydrogenation using H_2-Pt

11. The conversion of 2-pentanone to butanoic acid is best accomplished with:

(A) I_2, NaOH

(B) $NaBH_4$

(C) CrO_3

(D) Ag_2O

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12. A molecule has three degrees of unsaturation. In this molecule there would be

(A) three rings

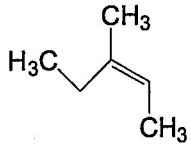
(B) three double bonds

(C) two rings and one double bond

(D) one ring and two double bonds

(E) any of the above

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



(A) (E)-3-methylpent-3-ene

(B) (Z)-3-methylpent-3-ene

(C) (E)-3-methylpent-2-ene

(D) (Z)-3-methylpent-2-ene

14. Which pair listed below is a Lewis acid-base pari?

(A) 2,6-di-*tert*-butylpyridine + HCl

(B) BF_3 + ether

(C) Benzoic acid + NaOH

(D) *tert*-butyl chloride + benzene

(E) acetone + H_2SO_4

15. Which statement is correct for the reaction shown below?

1-chloro-2,4-dinitrobenzene + NaOH → 2,4-dinitrophenol

(A) This reaction is an electrophilic aromatic substitution.

(B) This reaction is a SN2 substitution.

(C) This reaction is a nucleophilic aromatic substation.

(D) Substituted benzyne is the reaction intermediate.

16. Assuming the ionization energy of a hydrogen atom is E, estimate the 4f orbital energy for a Li2+ cation:

(A) 3E/4

(B) -3E/4

(C) 9E/16

(D) -9E/16

(E) E/4

17. Which of the following compounds is a suitable base to prepare ester enolate of ethyl acetate?

(A) Lithium diisopropylamide

(B) Pyridine

(C) Diisopropyl amine

(D) Pyrrolidine

18. In a solution of aspartic acid (pKa=7.4) adjusted to a pH of 2.74,

(A) the ration of asparate to asparatic acid is 10 to 1.

(B) the ration of asparate to asparatic acid is 100 to 1.

(C) the ration of asparate to asparatic acid is 1000 to 1.

(D) the ration of asparate to asparatic acid is 1 to 10.

(E) the ration of asparate to asparatic acid is 1 to 100.

19. Addition of Br_2 to (E)-hex-3-ene produces _____.

(A) A meso dibromide.

(B) A mixture of enantiomeric dibromides which is optically active.

(C) A mixture of enantiomeric dibromides which is optically inactive.

(D) (Z)-3,4-dibromo-3-hexene.

(E) (E)-3,4-dibromo-3-hexene.

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20. Which of the following compounds has the most negative heat of hydrogenation?
(A) 1,4-hexadiene (B) 1,5-hexadiene (C) 1,2-hexadiene (D) 1,3- hexadiene
(E) hex-1-ene

21. Which compounds is the most stable?
(A) 1,4-pentadiene (B) trans-1,3-pentadiene (C) trans-1,4-pentadiene
(D) cis-1,4-pentadiene

22. The Diels-Alder reaction is a concerted reaction; this means:
(A) A mixture of endo and exo products is formed.
(B) All bond making and bond breaking occurs simultaneously.
(C) The products contain rings.
(D) The reaction follows Markovnikov's rule.
(E) The reaction is highly endothermic.

23. Which of the statements below correctly describes an achiral molecular?
(A) The molecule has a non-superimposable mirror image.
(B) The molecule exhibits optical activity when it interacts with plane-polarized light.
(C) The molecule has an enantiomer
(D) The molecule might be meso form

24. The reaction conditions to carry out the production of cyclopentene using bromocycylpentane as the starting material would be:
(A) KOH, CH_3CH_3OH
(B) H_2SO_4, THF
(C) H_2O_2, OH^-
(D) $Hg(OAc)_2$, H_2O

25. Which is the reaction major product when benzene reacts with propene in the presence of HF?
(A) propylbenzene (B) iso propylbenzene (C) 3- propylbenzene (D)1- propylbenzene