

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 109 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. 作答中如有發現試題印刷不清，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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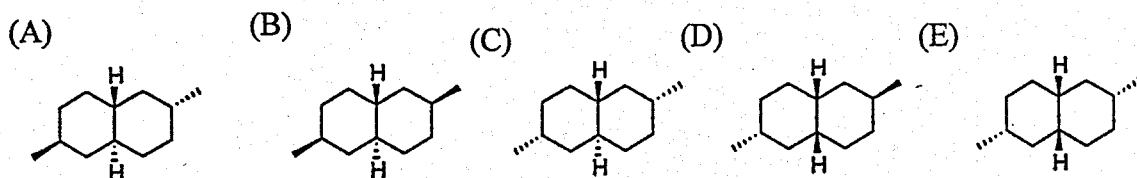
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考試科目（代碼）：有機化學(2905)

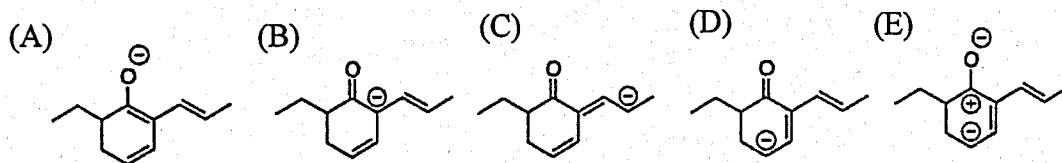
共_6_頁，第_1_頁 *請在【答案卡】作答

一、單選題，每題四分。

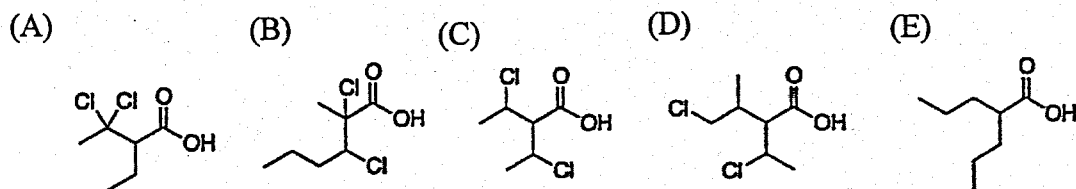
1. Which one of following structures has the lowest strain energy?



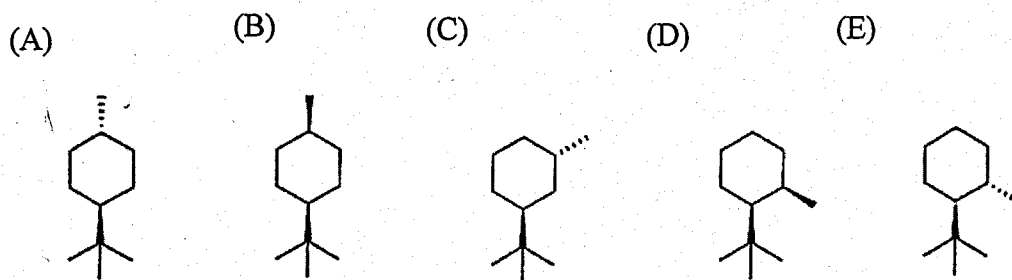
2. Which one of following structures is most stable based on resonance conformation.



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



4. Which one of following structures has the lowest strain energy?



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共 6 頁，第 2 頁 *請在【答案卡】作答

5. Which one of following structures has the lowest strain energy?

(A)



(B)



(C)



(D)

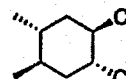
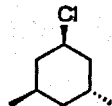
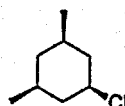
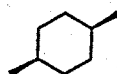
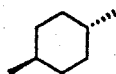


(E)

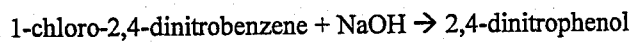


6. How many structures are meso compounds in following figure?

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5



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



(A) This reaction is an electrophilic aromatic substitution.

(B) This reaction is a S_N2 substitution.

(C) This reaction is a nucleophilic aromatic substitution.

(D) Substituted benzyne is the reaction intermediate.

8. Assuming the ionization energy of a hydrogen atom is E , estimate the 4f orbital energy for a Li^{2+} cation:

(A) $3E/4$

(B) $-3E/4$

(C) $9E/16$

(D) $-9E/16$

(E) $E/4$

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共_6_頁，第_3_頁 *請在【答案卡】作答

9. Please indicate which type of compounds are not derivatives of the nucleophilic acyl substitution reactions.

- (A) Ester
- (B) Amides
- (C) Acid anhydrides
- (D) Amines

10. 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

11. 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

12. 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

13. 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

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共_6_頁，第_4_頁 *請在【答案卡】作答

14. In a solution of aspartic acid ($pK_a=7.4$) 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.
15. 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.
16. 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.
17. 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
18. 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

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共_6_頁，第_5_頁 *請在【答案卡】作答

19. When pyridine is treated with a mixture of nitric and sulfuric acids, the major product is:
(A) 2-nitropyridine (B) 3-nitropyridine (C) 4-nitropyridine
(D) 3-aminopyridine (E) 4-aminopyridine
20. What is the major product which results when tetrahydrofuran is reacted with excess HBr?
(A) 1,2-dibromobutane (B) 1,3-dibromobutane (C) 1,4-dibromobutane
(D) 4-bromobutan-ol (E) 3-bromobutan-1-ol
21. Which of the following compound is the least reactive toward 1-propanol in Nucleophilic Acyl Substitution?
(A) acetyl bromide (B) acetamide (C) acetic anhydride (D) ethyl acetate
22. 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
23. Which of the following amines is most basic?
(A) aniline (B) N-ethylaniline (C) N,N-diethylaniline (D) piperidine
(E) pyrrole
24. Which reagent would convert cyclohexene into a *cis*-glycol?
(A) cold dilute potassium permanganate
(B) hydrogen peroxide and aqueous acetic acid
(C) ozone and moist zinc dust
(D) periodic acid (E) sodium tert-butoxide in chloroform

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25. What statement does NOT apply to the boiling points of alkanes?

- (A) The boiling point increases as the length of the carbon chain increase.
- (B) Straight chain alkanes have a higher boiling point than their branched isomers.
- (C) The boiling points are influenced by hydrogen bonding.
- (D) Because they are nonpolar, alkanes have lower boiling points than other organic compounds of similar molar mass.
- (E) The boiling points are affected by van der Waals attractions