

國立中山大學 113 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：有機化學及無機化學【化學系碩士班】

— 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

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題號：422001

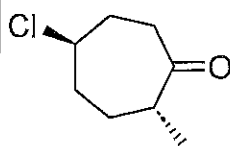
※本科目依簡章規定「不可以」使用計算機(混合題)

共 8 頁第 1 頁

一、選擇題 (2% × 43 = 86%)

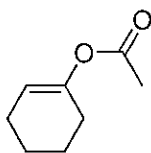
說明：全部單選，每題兩分，答錯不倒扣。

1. What is the correct IUPAC name for the following compound?

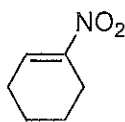


- (A) (2*R*,5*R*)-5-chloro-2-methylcycloheptan-1-one
 (B) (2*S*,5*R*)-5-chloro-2-methylcycloheptan-1-one
 (C) (2*R*,5*R*)-5-chloro-2-methylcyclohexan-1-one
 (D) (1*R*,5*R*)-1-chloro-5-methylcycloheptan-3-one
 (E) (1*R*,4*R*)-4-chloro-1-methylcycloheptan-7-one

2. Predict and arrange the reactivity of the following compounds in ascending order when reacting with HBr.



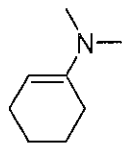
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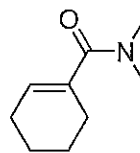
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3



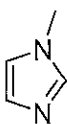
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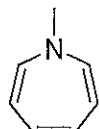
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- (A) 2 < 3 < 5 < 1 < 4
 (B) 5 < 3 < 2 < 4 < 1
 (C) 1 < 2 < 5 < 3 < 4
 (D) 4 < 1 < 3 < 5 < 2
 (E) 2 < 5 < 3 < 1 < 4

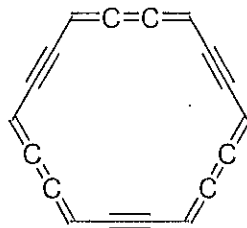
3. Which of the following structures, if flat, can be considered aromatic?



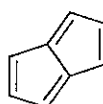
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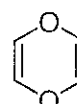
2



3



4



5

- (A) 1 only.
 (B) 3 and 5 only.
 (C) 2 and 4 only.
 (D) 1 and 3 only.
 (E) None of the above.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

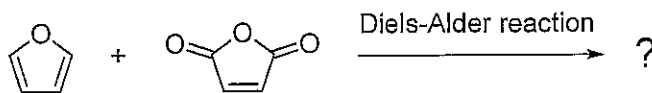
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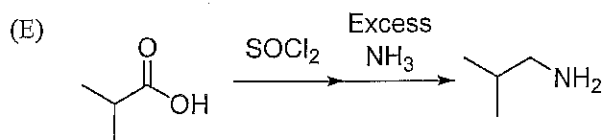
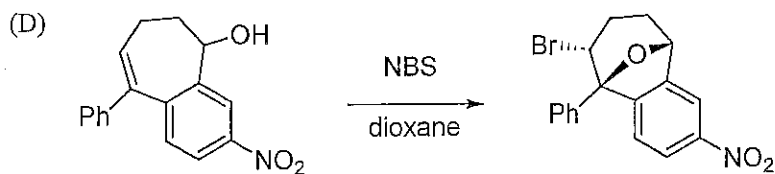
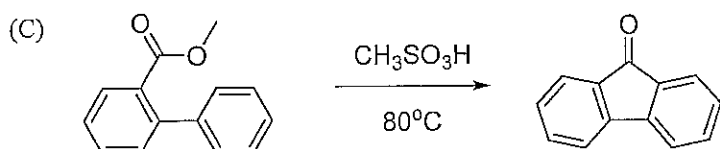
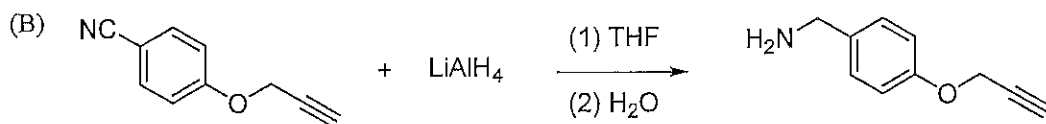
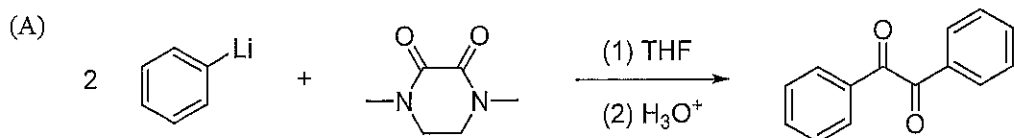
共 8 頁 第 2 頁

4. Which of the following is a correct Diels-Alder reaction product of the following reaction?



- (A) (B) (C) (D) (E)

5. Which of the following reaction will NOT give the product as shown?



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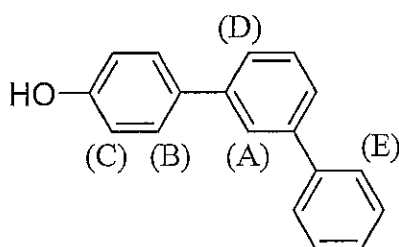
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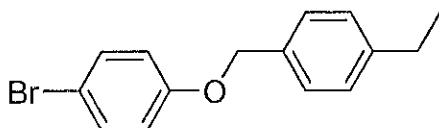
共 8 頁第 3 頁

6. Consider a system in which an ester is hydrolyzed in a base catalyzed hydrolysis using potassium hydroxide as the base. After the reaction, what will happen theoretically concerning the acidity of the reaction mixture when compared to the beginning of the reaction?
- (A) The mixture will become more basic compared to the beginning.
 (B) The mixture will become more acidic compared to the beginning.
 (C) The acidity of the reaction mixture will not change.
 (D) The concept of acidity cannot be applied to organic system.
 (E) The exact situations depend on the actual structure of the ester.

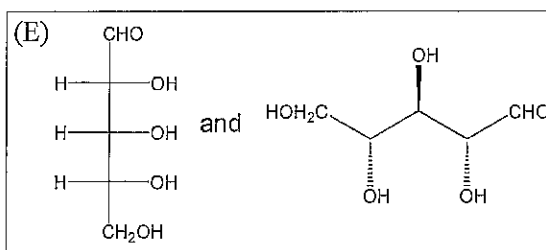
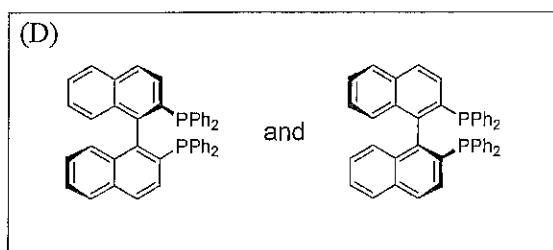
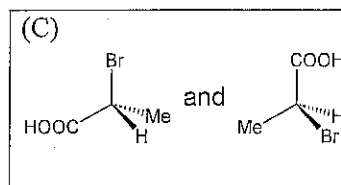
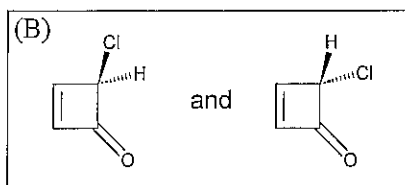
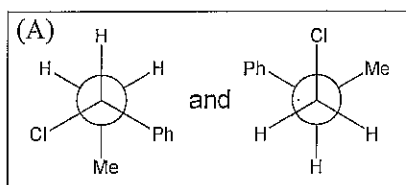
7. Which of the following position is the most reactive towards electrophilic aromatic substitution?



8. Describe the number of signals and their splitting in the ^1H NMR of the following compound:



- (A) 7 signals: 1 singlet, 2 doublets, 1 triplet, 3 quartet
 (B) 6 signals: 1 singlet, 3 doublets, 1 triplet, 1 quartet
 (C) 7 signals: 4 doublets, 2 triplet, 1 quartet
 (D) 7 signals: 1 singlet, 4 doublets, 1 triplet, 1 quartet
 (E) 8 signals: 2 singlet, 4 doublets, 1 triplet, 1 quartet
9. Which of the following pair of structures represent an identical compound?



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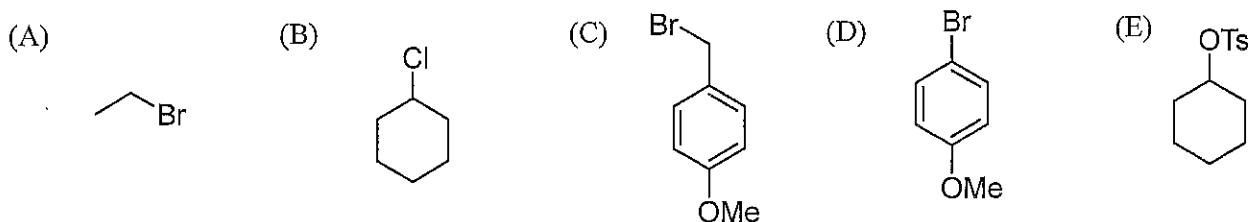
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共 8 頁第 4 頁

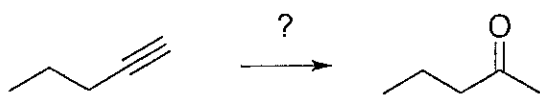
10. Which of the following solvent is the most soluble in water?

- (A) hexanoic acid
- (B) dichloromethane
- (C) dimethylformamide
- (D) 1-butanol
- (E) ethyl acetate

11. Which of the following compound is the most reactive in an S_N1 reaction?



12. Which of the following reaction conditions will give the desire product as shown?

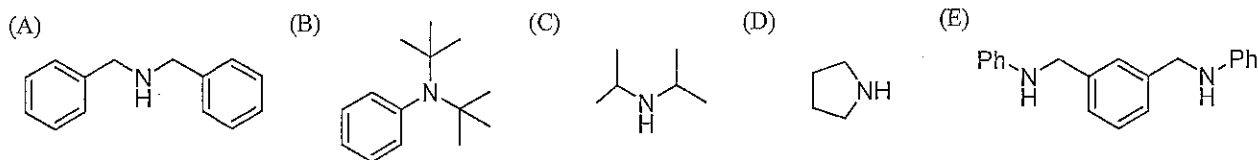


Reaction conditions:

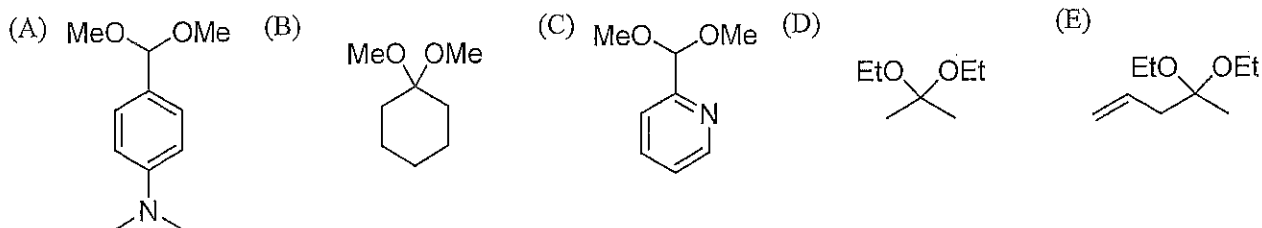
- (1) O_3
- (2) H_3O^+
- (3) Excess HBr, then excess KOH
- (4) BuLi, then H_2O

- (A) (1) and (2) only
- (B) (2) and (3) only
- (C) (2), (3) and (4) only
- (D) All of the above
- (E) None of the above

13. Which of the following amine CANNOT be synthesized by reductive amination?



14. Which of the following acetal will react the fastest in acid-catalyzed hydrolysis?



國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

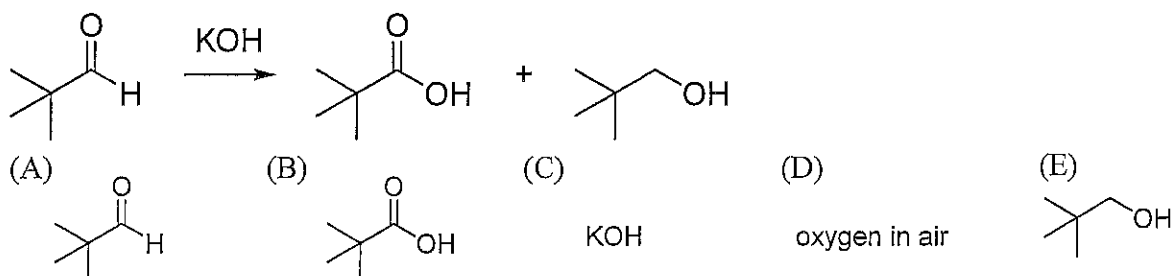
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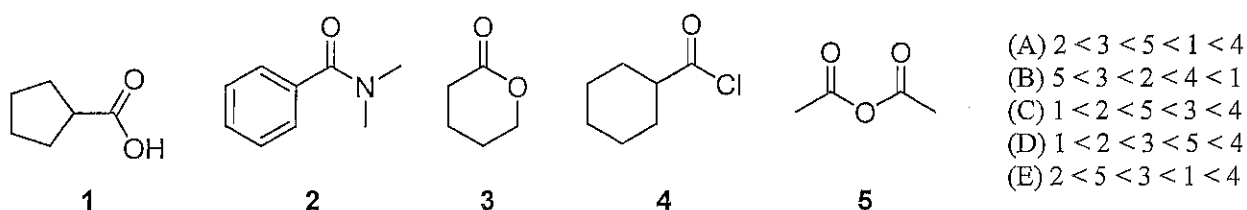
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共 8 頁第 5 頁

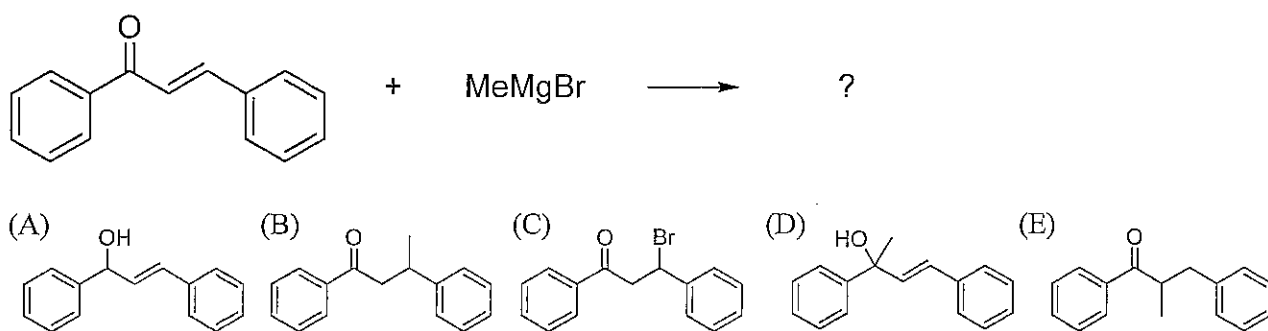
15. Which of the following compounds is the oxidant in the reaction below?



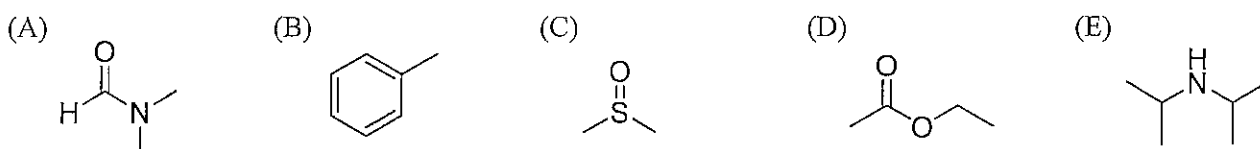
16. Rank the reactivity of the following compounds towards nucleophilic substitution of carboxylic acid derivative in increasing order (least to most).



17. Which of the following compound is most likely to be the major product of the following reaction?



18. Which of the following solvent is a protic solvent?



19. Which of the following description about S_N2 reaction is incorrect?

- (A) The rate of the reaction is second order.
- (B) Inversion of configuration at the reacting center will occur.
- (C) There is no intermediate in an S_N2 reaction.
- (D) Alkyl fluoride is very reactive in S_N2 reaction.
- (E) In S_N2 reaction, using polar aprotic solvents will give a faster reaction rate compare to polar protic solvents.

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共 8 頁第 6 頁

20. Which of the following statements is correct?
- (A) A chiral compound will always react to give a chiral product.
(B) The most stable conformation of *tert*-butylcyclohexane is with the *tert*-butyl group at the axial position.
(C) Aryl amines can be synthesized by reduction of nitroarenes.
(D) The Diels-Alder reaction involves rearrangement of electrons between the two HOMOs of the two reactants.
(E) A hard nucleophile will prefer to react with an α,β -unsaturated carbonyl compound in 1,4-addition instead of 1,2-addition.
21. Which of the following has the smallest radius?
(A) Ti^+ (B) Ti^{2+} (C) Ti^{3+} (D) Ti^{4+} (E) all of the above
22. Which of the following is not an inorganic compound?
(A) BeH_2 (B) BH_3 (C) CH_4 (D) NH_3 (E) H_2O
23. Which of the following is an organometallic compound?
(A) $[\text{HgMe}]^+$ (B) NaCl (C) PH_3 (D) $\text{Ti}(\text{NMe}_2)_4$ (E) $\text{Pd}(\text{OAc})_2$
24. Which of the following has the largest electronegativity?
(A) B (B) C (C) N (D) O (E) F
25. The E/R_H value for an electron at $n = 1$ in a He^+ cation, where $E =$ energy, $R_H =$ Rydberg constant = 13.61 eV, $n =$ principal quantum number, is
(A) -1 (B) -2 (C) -3 (D) -4 (E) none of the above
26. Among the following compounds, which is not isoelectronic with the others?
(A) BH_3 (B) CH_4 (C) NH_3 (D) H_2O (E) HF
27. Among the following compounds, whose molecular dipole is not zero?
(A) PF_5 (B) PF_3Cl_2 (C) PF_2Cl_3 (D) P_4 (E) BF_3
28. Among the following compounds, which has the largest bond angle?
(A) NF_3 (B) PF_3 (C) AsF_3 (D) SbF_3 (E) all of the above
29. Among the following compounds, whose point group is C_{2v} ?
(A) BF_3 (B) CF_4 (C) NF_3 (D) SF_4 (E) none of the above
30. Which of the following is chiral?
(A) C_2H_2 (B) N_2H_2 (C) H_2O_2 (D) SeCl_4 (E) none of the above
31. In $\text{Mo}(\text{CO})_6$, the number of IR-active C-O stretching vibrations is
(A) 1 (B) 2 (C) 3 (D) 4 (E) none of the above
32. In aqueous solutions, which of the following is the strongest acid?
(A) HNO_3 (B) H_2SO_4 (C) HClO_4 (D) HCl (E) all of the above
33. The spin multiplicity of KO_2 is
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

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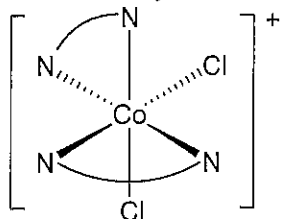
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共 8 頁第 7 頁

34. Which of the following is the softest Lewis base?
 (A) F^- (B) OH^- (C) H_2O (D) CO_3^{2-} (E) H^-
35. The coordination geometry of $Ni(CO)_4$ is
 (A) see-saw (B) square planar (C) tetrahedral (D) trigonal pyramidal (E) none of the above

36. The chirality label for the dichlorobis(ethylenediamine)cobalt(III) cation shown below is



- (A) Δ -cis- (B) Δ -trans- (C) Λ -cis- (D) Λ -trans- (E) none of the above
37. As a ligand, CO is a
 (A) σ donor and π donor (B) σ donor and π acceptor (C) σ acceptor and π donor (D) σ acceptor and π acceptor (E) none of the above
38. Which of the following does not show a Jahn-Teller effect?
 (A) $[Cr(H_2O)_6]^{2+}$ (B) $[Mn(H_2O)_6]^{2+}$ (C) $[Fe(H_2O)_6]^{2+}$ (D) $[Co(H_2O)_6]^{2+}$ (E) none of the above
39. The highest occupied molecular orbital(s) of $[CuCl_2]^-$ is/are
 (A) $3d_{x^2-y^2}$, $3d_{z^2}$ (B) $3d_{xy}$, $3d_{xz}$, $3d_{yz}$ (C) $3d_{xz}$, $3d_{yz}$ (D) $3d_{z^2}$ (E) none of the above
40. Which of the following has a d-d transition?
 (A) TiO_2 (B) VO_2 (C) CrO_3 (D) MnO_4^- (E) none of the above
41. The metal-metal bond order of $Mo_2(\eta^5-C_5H_5)_2(CO)_4$ is
 (A) 0 (B) 1 (C) 2 (D) 3 (E) none of the above
42. Which of the following is the strongest trans influence ligand?
 (A) Cl^- (B) OH^- (C) NH_3 (D) H^- (E) CO
43. In $Fe(\eta^x-C_5H_5)(\eta^5-C_5H_5)(CO)_2$, $x =$
 (A) 2 (B) 3 (C) 4 (D) 5 (E) none of the above

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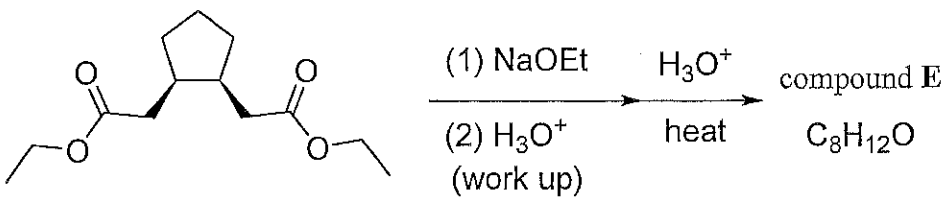
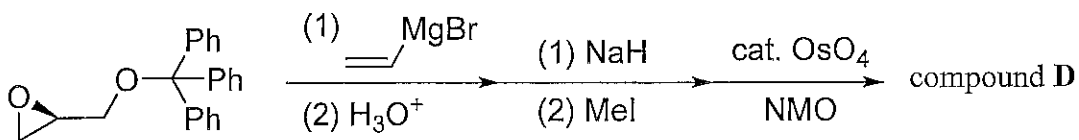
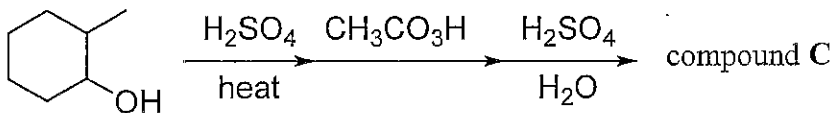
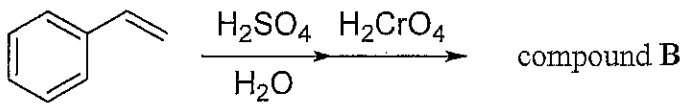
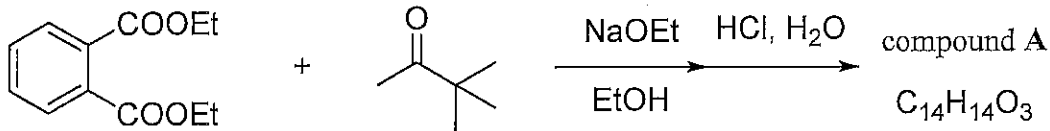
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共 8 頁第 8 頁

二、非選擇題 (14%)

1. Draw the major product of each of the following reactions with correct stereochemistry where necessary: (2% × 5 = 10%)



2. Draw products F and G, where F is an organometallic complex. (2% × 2 = 4%)

