

國立臺灣師範大學 113 學年度碩士班招生考試試題

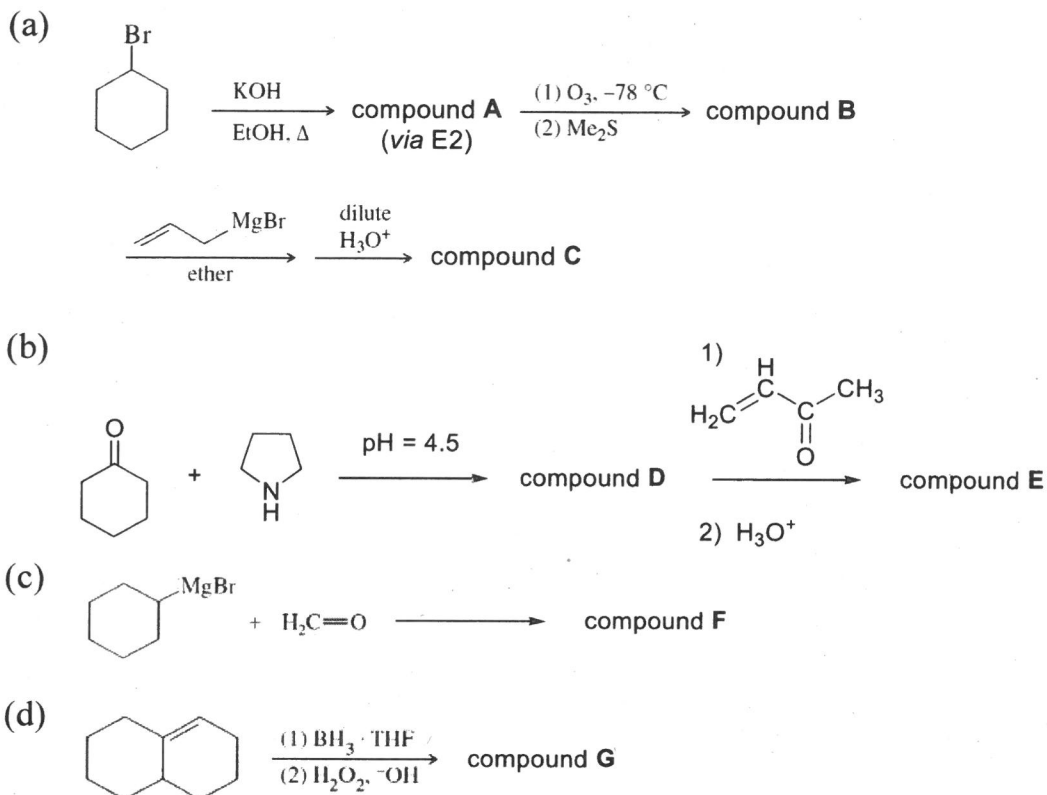
科目：有機化學

適用系所：化學系

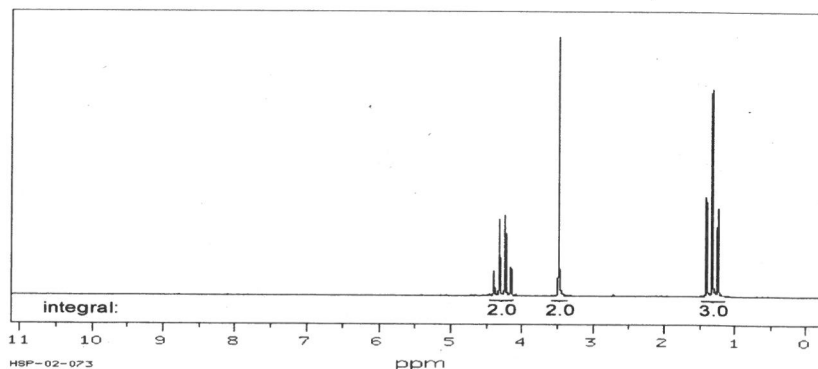
注意：1. 本試題共 13 頁，請依序在答案卷上作答，並標明題號，不必抄題。2. 答案必須寫在指定作答區內，否則依規定扣分。

一、非選擇題 (共 30 分)

1. (17.5 分) Predict the structures of compounds A-G in the following reactions:

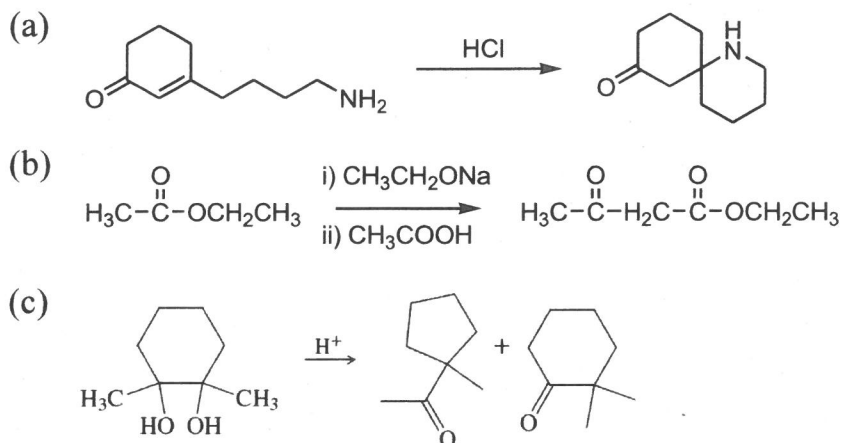


2. (2.5 分) The mass spectrum of the compound shows a molecular ion at $m/z = 113$, and the elementary analysis shows that this compound contains 4 different elements. The IR spectrum has characteristic absorptions at 2270 and 1735 cm^{-1} , and the ^{13}C NMR spectrum has five signals. The proton NMR spectrum is shown. Determine the structure of the compound.



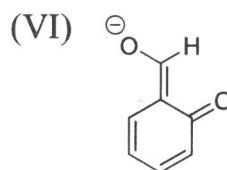
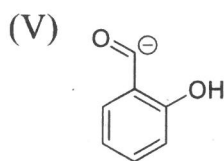
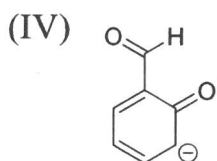
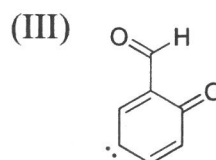
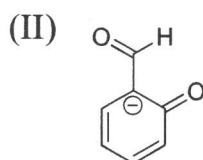
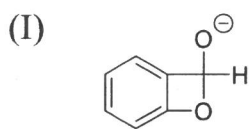
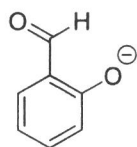
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3. (10 分) Propose mechanisms for the following reactions:



二、 單選題 (每題 2 分，共 70 分)

1. Which of the following are not resonance structures of the phenoxide structure shown below?



(A) I, V only (B) I, VI only (C) I, III, V only (D) III, V only
(E) III, V, VI only

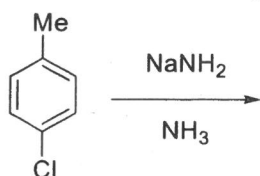
2. Rank the following molecules in increasing order of acidity (least acidic to most acidic):

(I) benzoic acid (II) *p*-nitrobenzoic acid (III) phenol
(IV) *p*-methoxyphenol

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

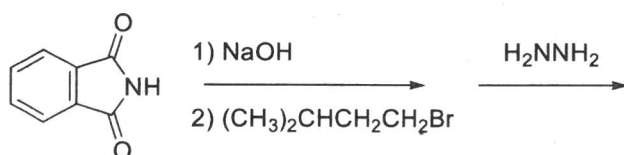
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3. Which of the following is(are) the product(s) obtained from the following reaction:

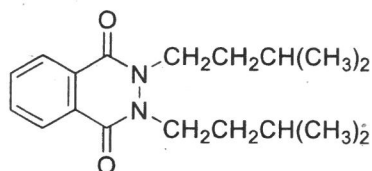


- (I) *o*-methylaniline (II) *m*-methylaniline (III) *p*-methylaniline
 (IV) toluene
 (A) I only (B) II only (C) III only (D) IV only (E) II and III

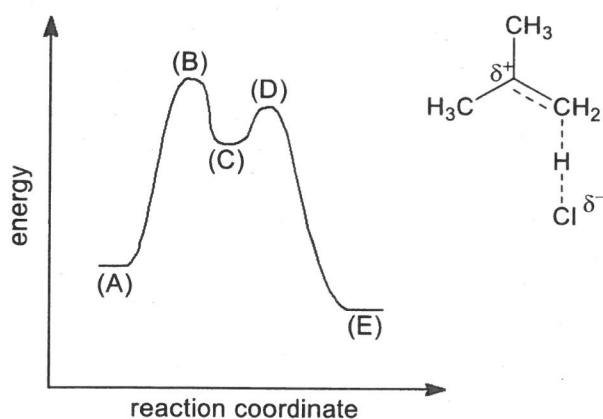
4. What is the product of the reaction shown below?



- (A) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{NHNH}_2$
 (B) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{NH}_2$
 (C) $((\text{CH}_3)_2\text{CHCH}_2\text{CH}_2)_2\text{NH}$
 (D) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CONH}_2$
 (E)

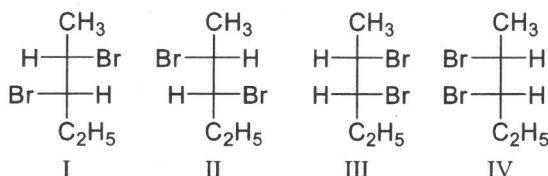
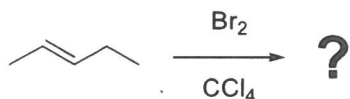


5. Which point on the potential energy diagram corresponds to the species below for the reaction of 2-methylpropene with hydrogen chloride?

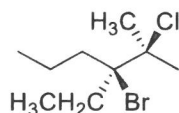


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6. Which of the statements is most correct regarding the products expected from the halogenation reaction shown below?



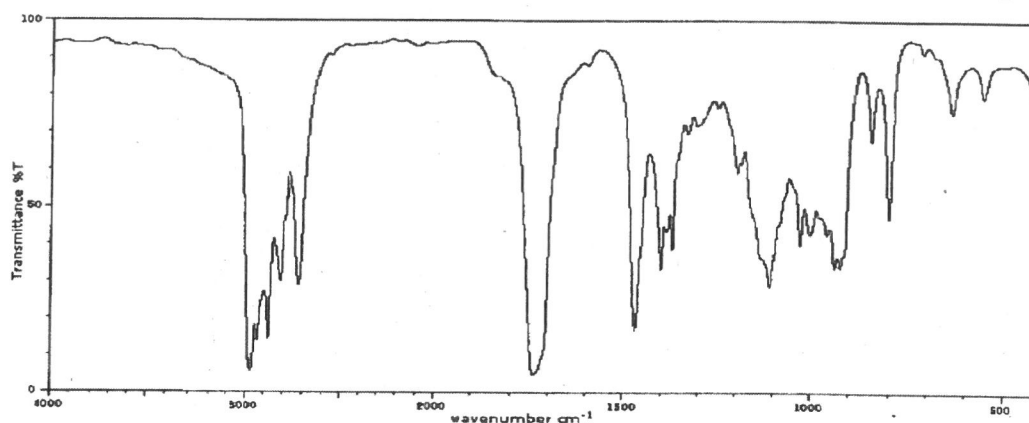
- (A) Equal amounts of I and II are produced
 (B) Equal amounts of I and III are produced
 (C) Equal amounts of I and IV are produced
 (D) Equal amounts of II and IV are produced
 (E) Equal amounts of III and IV are produced
7. What is the correct Newman projection for the following molecule?



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

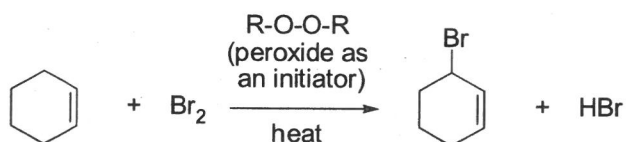
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8. Which of the following compounds is consistent with the following IR spectrum?



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

9. Which of the following is(are) the propagation step(s) in the bromination of cyclohexene shown below:

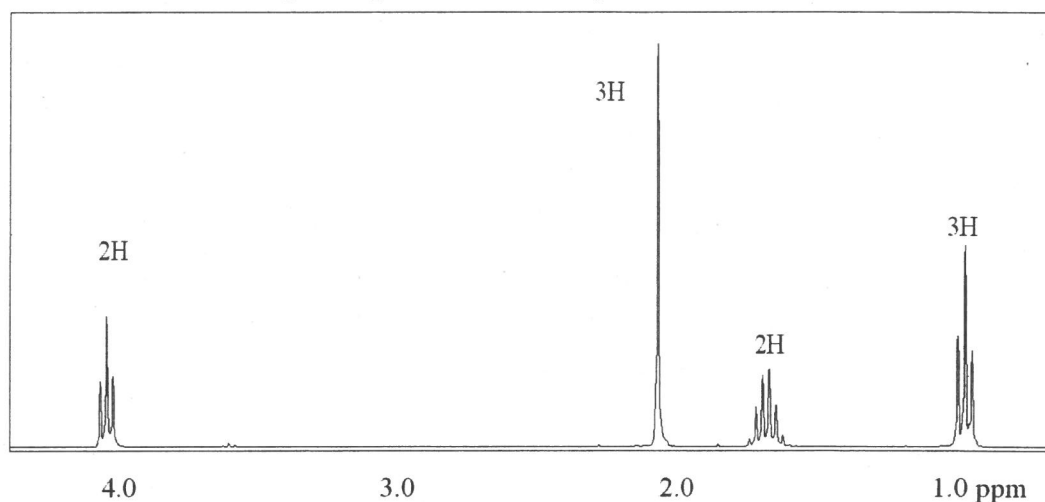


- I. $\text{RO-OR} \longrightarrow 2 \text{RO}\cdot$
- II. $\text{RO}\cdot + \text{Cyclohexene} \longrightarrow \text{RO-H} + \text{Cyclohexyl radical}$
- III. $\text{Br}\cdot + \text{Cyclohexene} \longrightarrow \text{Br-H} + \text{Cyclohexyl radical}$
- IV. $\text{Br}_2 + \text{Cyclohexyl radical} \longrightarrow \text{Br}\cdot + \text{3-bromocyclohexene}$
- V. $\text{Br}\cdot + \text{Cyclohexyl radical} \longrightarrow \text{3-bromocyclohexene}$

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

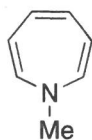
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10. Which of the following compounds fits the proton NMR shown below?



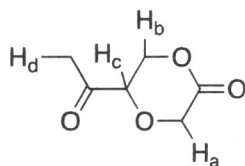
- (A) $\text{CH}_3\text{CH}_2\text{CH}_2-\text{C}(=\text{O})-\text{OCH}_3$ (B) $\text{CH}_3\text{CH}_2-\text{C}(=\text{O})-\text{OCH}_2\text{CH}_3$
 (C) $\text{CH}_3-\text{C}(=\text{O})-\text{OCH}_2\text{CH}_2\text{CH}_3$ (D) $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_2\text{CH}_2\text{OCH}_3$
 (E) $\text{CH}_3-\text{O}-\text{CH}_2\text{CH}_2\text{CH}_3$

11. Which description accurately characterizes the following compound?



- (A) contains 8 π electrons and is nonaromatic
 (B) contains 8 π electrons and is aromatic
 (C) contains 8 π electrons and is antiaromatic
 (D) contains 6 π electrons and is nonaromatic
 (E) contains 6 π electrons and is aromatic

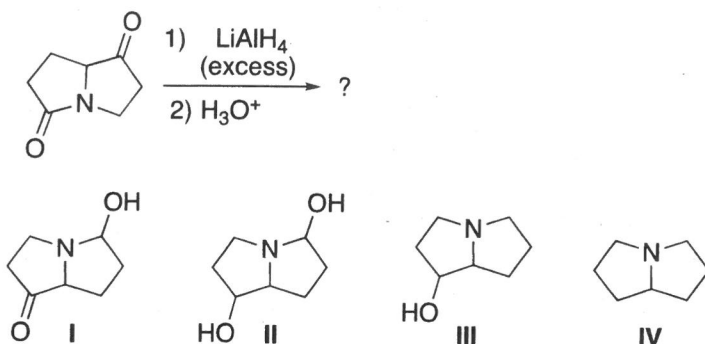
12. Which among the provided predictions of the chemical shifts (ppm) for the signals corresponds accurately to the compound listed below?



- (A) $a = 5.2; b = 5.7; c = 1.9; d = 4.4$ (B) $a = 1.9; b = 5.7; c = 5.2; d = 4.4$
 (C) $a = 4.4; b = 5.2; c = 1.9; d = 1.9$ (D) $a = 5.7; b = 5.2; c = 4.4; d = 1.9$
 (E) $a = 5.2; b = 4.4; c = 5.7; d = 1.9$

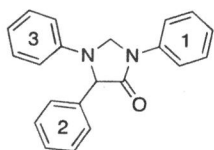
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13. Predict the **major** product for the following reaction.



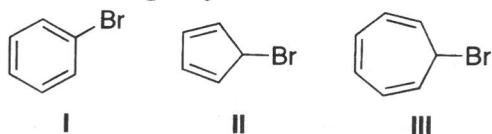
(A) I and II (B) IV (C) III (D) II (E) I

14. What is the order of increasing reactivity in the electrophilic aromatic substitution reactions for the following aromatic rings in the given compound? Please rank them from least to more reactive.



(A) $1 < 3 < 2$ (B) $2 < 1 < 3$ (C) $2 < 3 < 1$ (D) $3 < 2 < 1$ (E) $1 < 2 < 3$

15. Please identify the compound(s) from the list below that undergoes solvolysis in water most rapidly?

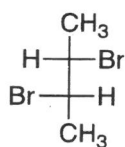


(A) III (B) II (C) I (D) II and III (E) all the above

16. Given that (*R*)-2-Bromobutane exhibits a specific rotation of -23.1° . What is the ratio of (*R*)-2-Bromobutane and (*S*)-2-Bromobutane when the measured rotation reaches $+18.5^\circ$?

(A) (*S*) : (*R*) = 1 : 2 (B) (*S*) : (*R*) = 1 : 6 (C) (*S*) : (*R*) = 2 : 1
(D) (*S*) : (*R*) = 9 : 1 (E) (*S*) : (*R*) = 12 : 1

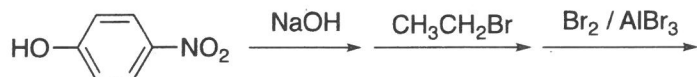
17. Please provide the name for the following structure.



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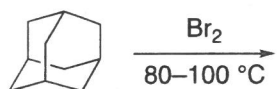
- (A) (2*S*, 3*S*)-Dibromobutane (B) (2*R*, 3*R*)-Dibromobutane
 (C) (2*S*, 3*R*)-Dibromobutane (D) (2*R*, 3*S*)-Dibromobutane
 (E) 2,3-Dibromobutane

18. What is the final product resulting from the following reaction sequence?

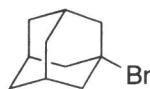


- (A) 4-Bromonitrotoluene (B) 3-Bromo-6-ethyl-4-nitrophenol
 (C) 6-Bromo-2-ethyl-4-nitrophenol (D) 2-Bromo-1-ethylphenol
 (E) 2-Bromo-1-ethoxyl-4-nitrobenzene

19. What is the resultant product of the reaction shown below?



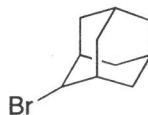
(A)



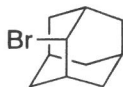
(B)



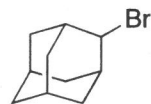
(C)



(D)



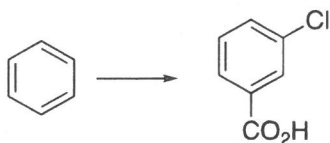
(E)



(20~21) To complete the following multistep synthesis, please choose right reagent(s) from the below list and arrange in a suitable order.

- I) $\text{KMnO}_4, \text{H}_3\text{O}^+$ II) $\text{Br}_2 / \text{FeBr}_3$ III) $\text{Cl}_2 / \text{FeCl}_3$ IV) $\text{CH}_3\text{Cl} / \text{AlCl}_3$
 V) $\text{HNO}_3, \text{H}_2\text{SO}_4$ VI) $\text{CH}_3(\text{CH}_2)_2\text{COCl} / \text{AlCl}_3$
 VII) $\text{CH}_3(\text{CH}_2)_3\text{Cl} / \text{AlCl}_3$ VIII) $\text{H}_2, \text{Pd/C}$ IX) NBS, peroxides

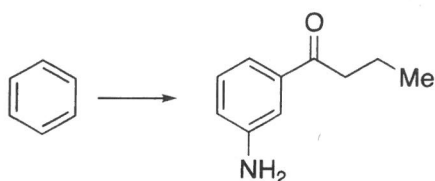
20.



- (A) IV $\rightarrow$ I $\rightarrow$ III (B) III $\rightarrow$ IV $\rightarrow$ I (C) II $\rightarrow$ I $\rightarrow$ IV (D) IV $\rightarrow$ III $\rightarrow$ I
 (E) I $\rightarrow$ III $\rightarrow$ IV

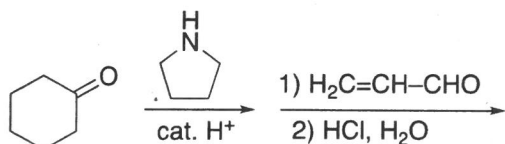
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21.



- (A) V→VIII→VI (B) V→VII→I→VIII (C) V→VIII→VII
(D) V→VI→VIII (E) V→I→VI→VIII

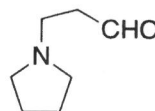
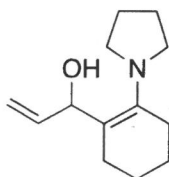
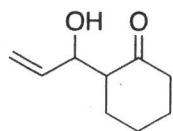
22. What is the major product of the following reaction?



(A)

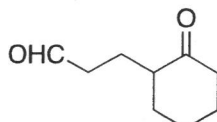
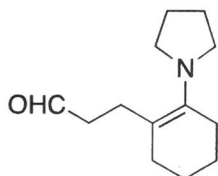
(B)

(C)



(D)

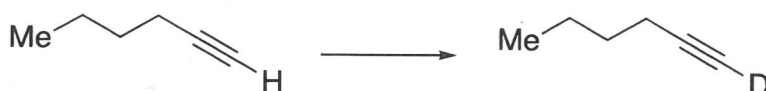
(E)



23. When indole is treated with Br_2 in dioxane at 0°C , the major product is?

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

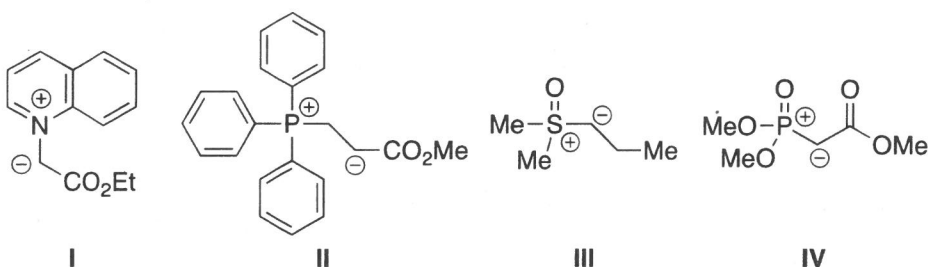
24. To accomplish the below transformation, which specific set of reagents is required?



- (A) $(\text{Sia})_2\text{BD}$ then D_2O (B) $n\text{BuLi}$ then D_3O^+ (C) Li / ND_3
(D) LiAlD_4 then D_2O (E) NaBD_4 in CD_3OD

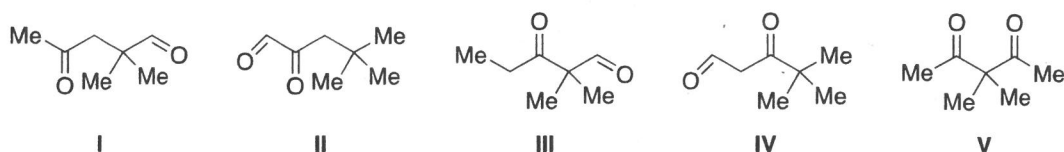
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25. Which one is ylide?



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

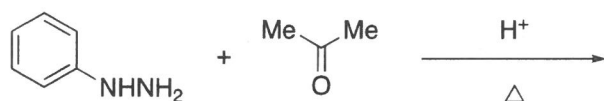
(26-27) Among the compounds listed below, all with the formula $C_7H_{12}O_2$.



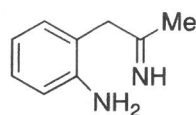
26. Which one would exhibit a 1H NMR spectrum comprising solely four singlets?
(A) I (B) II (C) III (D) IV (E) V

27. How many ^{13}C signals are expected for the molecule mentioned above?
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

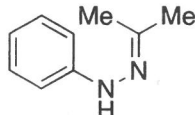
28. What is the end product resulting from the transformation listed below?



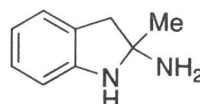
(A)



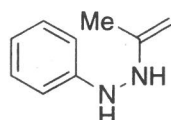
(B)



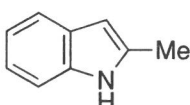
(C)



(D)

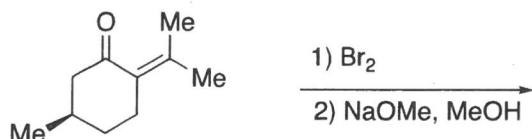


(E)

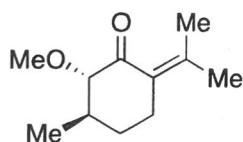


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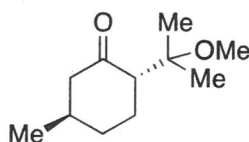
29. What is the end product resulting from the transformation listed below?



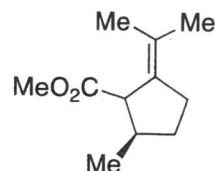
(A)



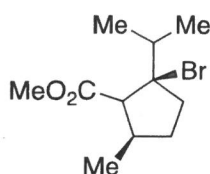
(B)



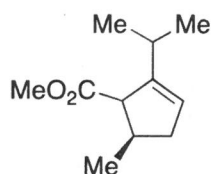
(C)



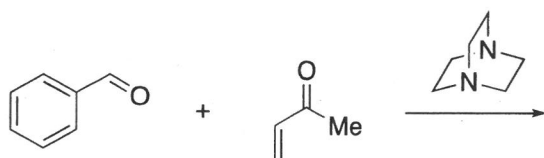
(D)



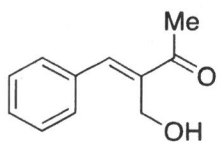
(E)



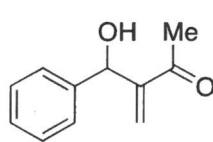
30. What is the end product resulting from the transformation listed below?



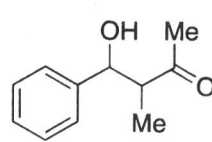
(A)



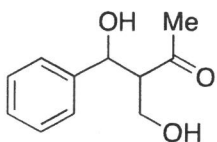
(B)



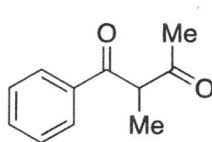
(C)



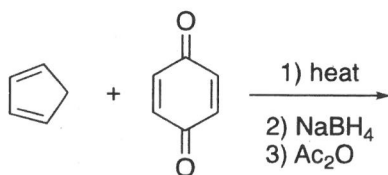
(D)



(E)

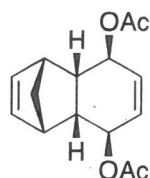


31. What is the end product resulting from the transformation listed below?

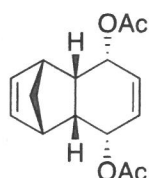


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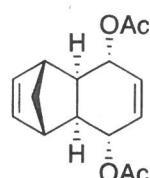
(A)



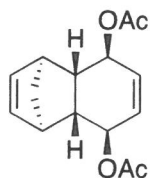
(B)



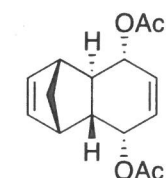
(C)



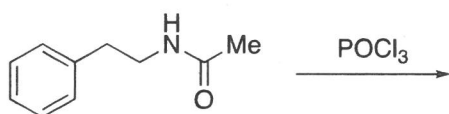
(D)



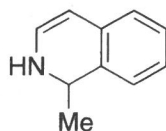
(E)



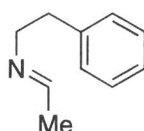
32. What is the end product resulting from the transformation listed below?



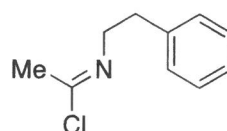
(A)



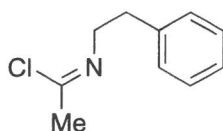
(B)



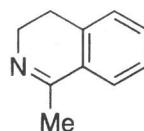
(C)



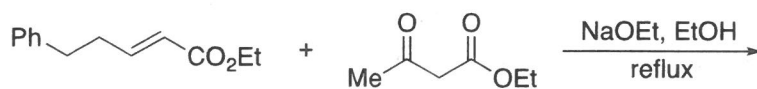
(D)



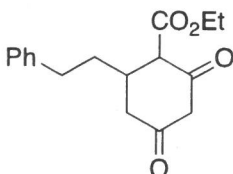
(E)



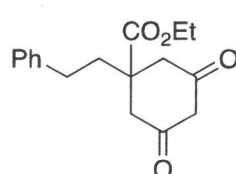
33. What is the end product resulting from the transformation listed below?



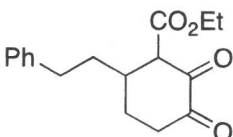
(A)



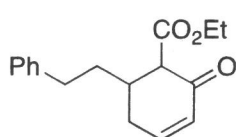
(B)



(C)



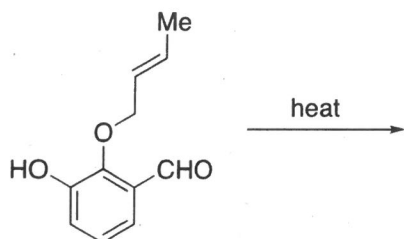
(D)



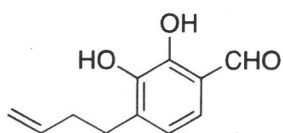
(E) None of the above

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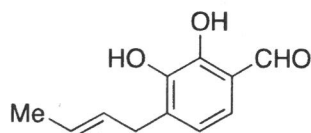
34. What is the major end product resulting from the transformation listed below?



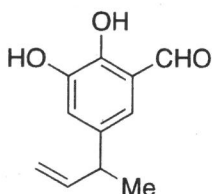
(A)



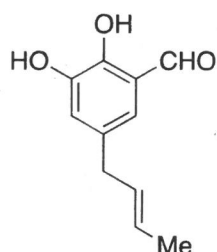
(B)



(C)

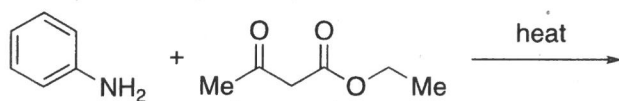


(D)

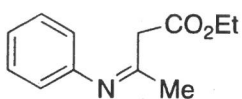


(E) None of the above

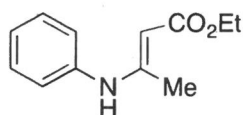
35. What is the major end product resulting from the transformation listed below?



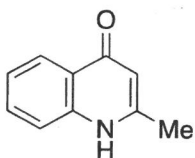
(A)



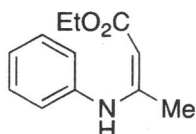
(B)



(C)



(D)



(E) None of the above