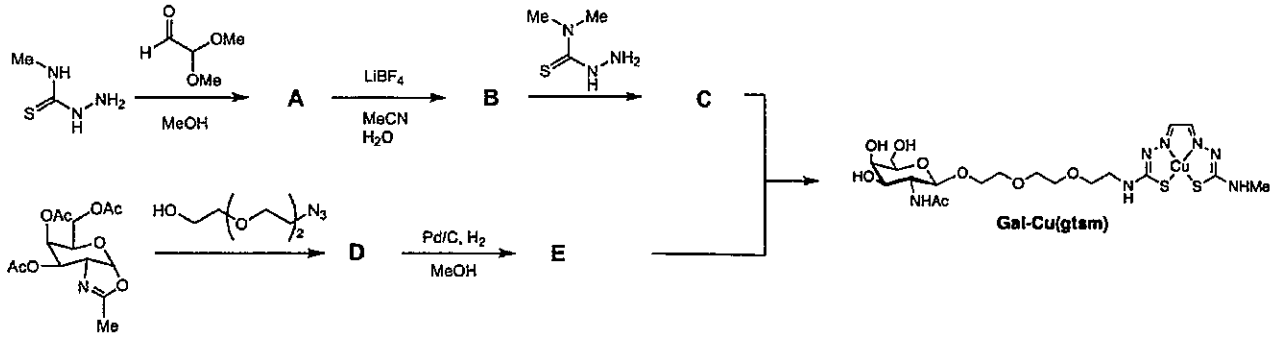
國立臺灣師範大學 109 學年度碩士班招生考試試題

科目：有機化學　　適用系所：化學系

注意：1.本試題共 11 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。

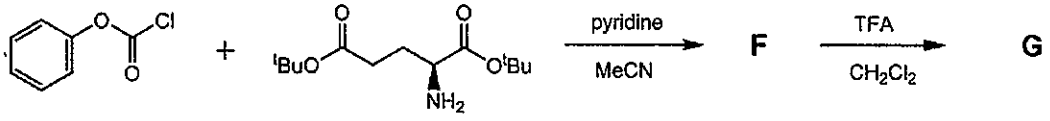
一、非選擇題：(共 40 分)

1. Copper is a required nutrient for all living organisms. In order to solve the problem of copper deficiency. N-acetylgalactosamine-functionalized ionophore, Gal-Cu (gtsm), was synthesized and serve as a copper-carrying "Trojan Horse" that targets liver-localized asialoglycoprotein receptors (ASGPRs) and releases copper only after being taken up by cells. The synthesis procedure is described below. Please write down the structures (**A-E**, 3 points each, 15 points total)

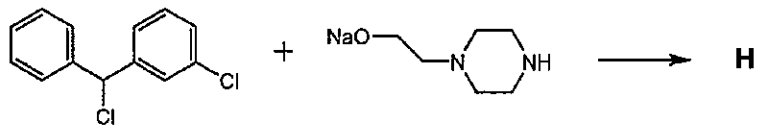


2. Please write down the structure of major product in the following transformation. The structure should include stereochemistry where appropriate. (3 points each, 15 points total)

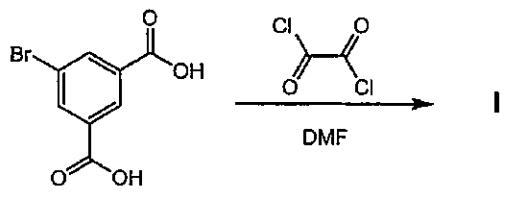
(a)



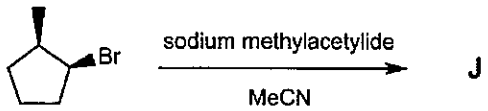
(b)



(c)

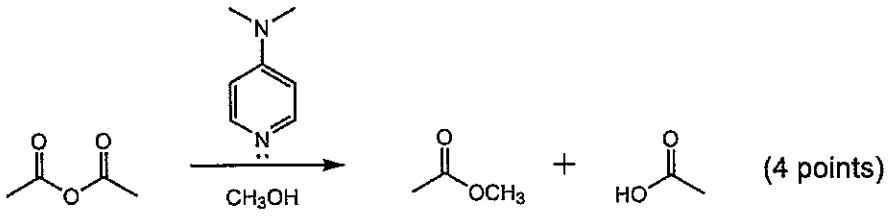


(d)



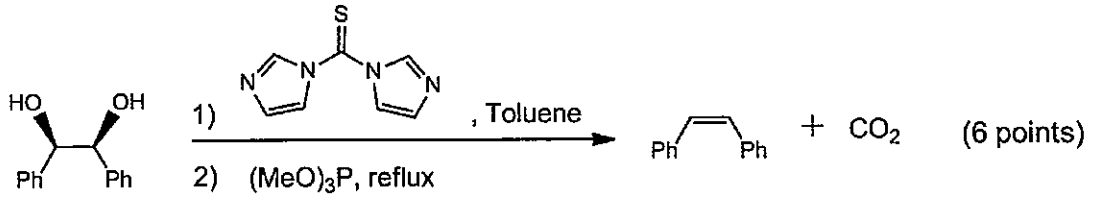
3. Please provide a reasonable mechanism for the following transformation

(a)



(4 points)

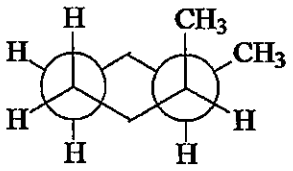
(b)



(6 points)

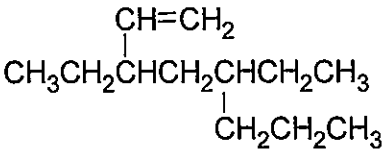
二、單選題 (30 題，每題 2 分，共 60 分)

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



(A) *cis*-1,2-dimethylcyclohexane
(B) *trans*-1,2-dimethylcyclohexane
(C) 1,1-dimethylcyclohexane
(D) *cis*-1,3-dimethylcyclohexane
(E) 1,1-dimethylcyclobutane

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



(A) 3-ethyl-propyl-1-heptene
(B) ethyl-3-vinyloctane
(C) 4,6-diethyl-1-octene
(D) 3,5-diethyl-1-octene
(E) 4,6-diethyl-7-octene

3. Which of the following are the chain propagating steps in the free radical chlorination of methane?

I. $Cl_2 \longrightarrow 2\ Cl\cdot$

II. $Cl_2 + H\cdot \longrightarrow 2HCl + Cl\cdot$

III. $CH_4 + Cl\cdot \longrightarrow \cdot CH_3 + HCl$

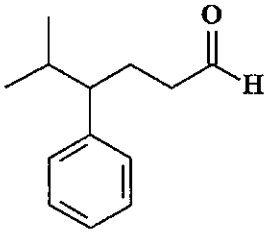
IV. $CH_4 + H\cdot \longrightarrow \cdot CH_3 + H_2$

V. $\cdot CH_3 + Cl_2 \longrightarrow CH_3Cl + Cl\cdot$

VI $\cdot CH_3 + Cl\cdot \longrightarrow CH_3Cl$

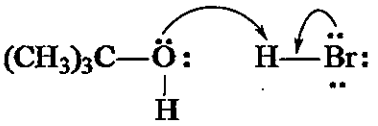
(A) I and III (B) II and VI (C) III and IV
(D) III and V (E) I and VI

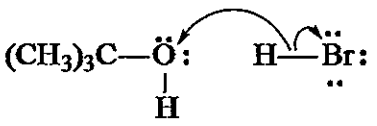
4. Identify the correct IUPAC name of the compound below:

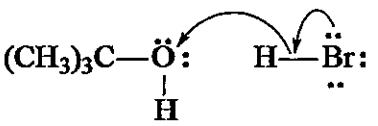


(A) 4-benzyl-5-methylhexanal (B) 5-isopropyl-5-phenylbutanal
(C) 2-methyl-3-phenylhexanal (D) 5-methyl-4-phenylhexanal
(E) 2-methyl-3-phenyl-6-oxohexane

5. Which of the following mechanistically depicts the protonation of *tert*-butyl alcohol by hydrogen bromide?

(A)


(B)


(C)


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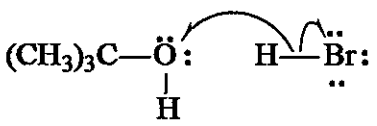
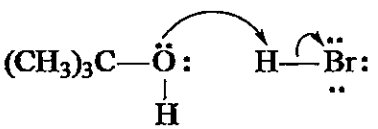
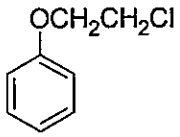
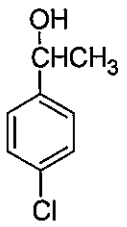


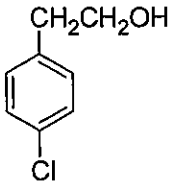
(E)


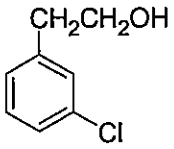
6. The proton NMR of a compound, C_8H_9ClO, has the following peaks. Which compound below best fits the data?

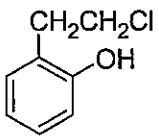
δ 2.41 (1H)	broad singlet
δ 2.75 (2H)	triplet
δ 3.69 (2H)	triplet
δ 7.02 (2H)	doublet
δ 7.50 (2H)	doublet

(A) 

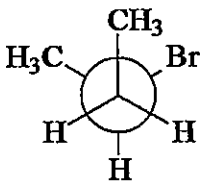
(B) 

(C) 

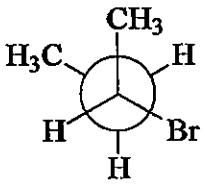
(D) 

(E) 

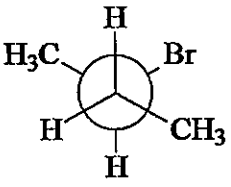
7. In the dehydrohalogenation of 2-bromobutane, which conformation below leads directly to the formation of *cis*-2-butene?



I



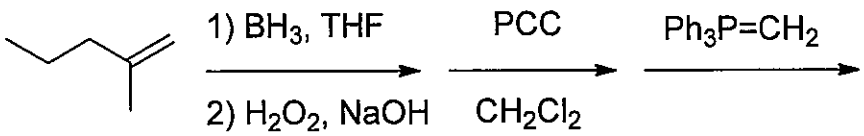
II



III

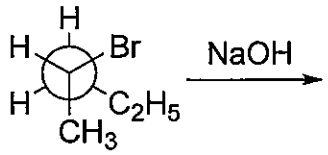
(A) only I (B) only II (C) only III
(D) I and II (E) I and III

8. What is the product of the reaction sequence below?

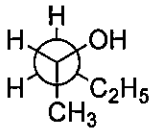


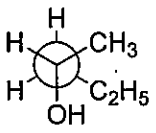
(A) 2-methyl-1-hexene (B) 2,3-dimethyl-2-pentene
(C) 2-methyl-2-hexene (D) 3-methyl-1-hexanone
(E) 3-methyl-1-hexene

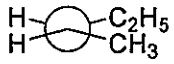
9. In the following nucleophilic substitution reaction:

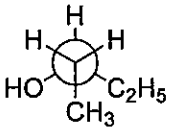


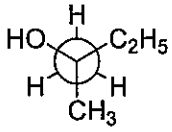
which of the Newman projection(s) can represent the product(s)?

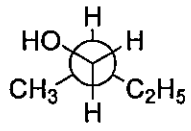
I 

II 

III 

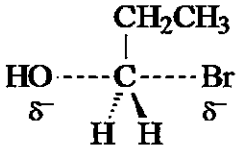
IV 

V 

VI 

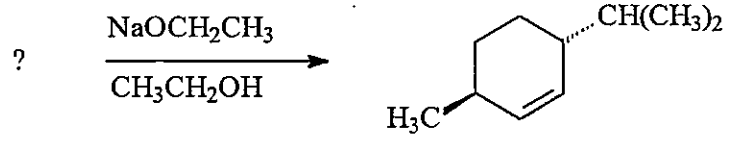
(A) only I (B) only II (C) only IV
(D) III and IV (E) V and VI

10. The species shown below represents the transition state for the:

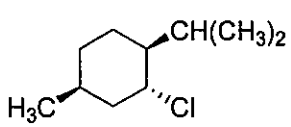


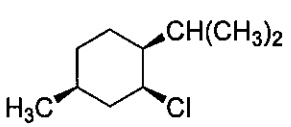
(A) reaction of 1-propanol with HBr
(B) reaction of 1-bromopropane with NaOH
(C) elimination of HBr from 1-bromopropane
(D) addition of HBr to propene with peroxides
(E) addition of Br_2 to propene in H_2O

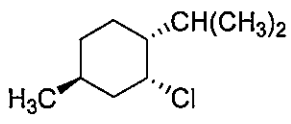
11. Which of the following stereoisomers gives the <u>exclusive E2 product</u> shown?

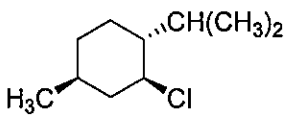


(only E2 product)

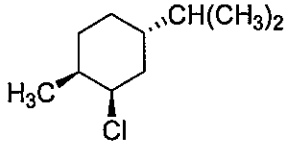
(A) 

(B) 

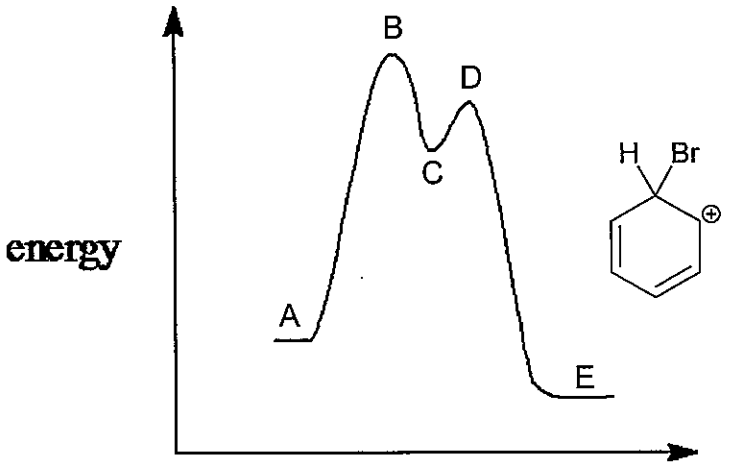
(C) 

(D) 

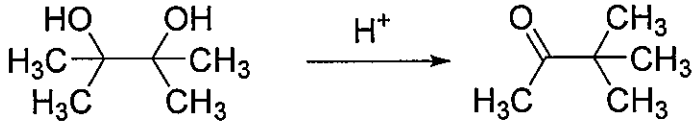
(E)



12. Which point on the potential energy diagram corresponds to the species shown to the right for the electrophilic bromination of benzene with $Br_2/FeBr_3$?

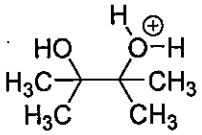


13. For the acid catalyzed reaction shown below:

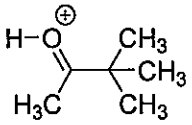


which of the following structure is not the intermediate in the reaction?

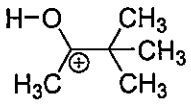
(A)



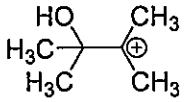
(B)



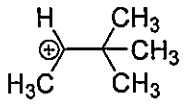
(C)



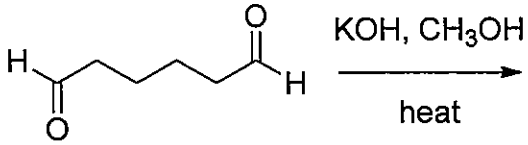
(D)

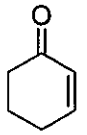


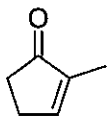
(E)

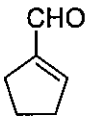


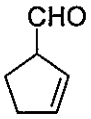
14. What is the product of the reaction shown?



(A) 

(B) 

(C) 

(D) 

(E) 

15. Which of the following syntheses gives 3-methyl-1-hexanol?

(A) 3-methylhex-1-ene $\xrightarrow[H_2O]{OsO_4 \quad Na_2SO_3}$

(B) 2-bromopentane $\xrightarrow[\text{diethyl ether}]{Mg}$ $\xrightarrow[2)\ H^+]{1)\ \text{epoxide}}$

(C) 3-bromopentane $\xrightarrow[\text{diethyl ether}]{Mg}$ $\xrightarrow[2)\ H^+]{1)\ H_3C{-}C(=O){-}H}$

(D) 1-bromobutane $\xrightarrow[\text{diethyl ether}]{Mg}$ $\xrightarrow[2)\ H^+]{1)\ H_3C{-}C(=O){-}CH_3}$

(E) 2-bromohexane $\xrightarrow[\text{diethyl ether}]{Mg}$ $\xrightarrow[2)\ H^+]{1)\ H_2C{=}O}$

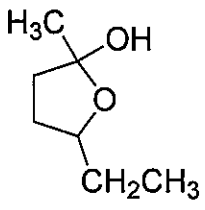
16. Predict the major product(s) in the reactions below:

$$HC{\equiv}CH \xrightarrow[2)\ CH_3Br]{1)\ NaNH_2} \xrightarrow[2)\ \text{1-iodohexane}]{1)\ NaNH_2} \xrightarrow{Na,\ NH_3(liq.)}$$

(A) 1-nonyne (B) 2-nonyne (C) *cis*-2-nonene

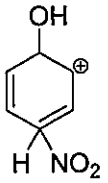
(D) *trans*-2-nonene (E) *trans*-3-nonene

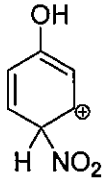
17. The compound shown below is the cyclic hemiacetal of:

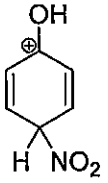


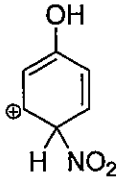
(A) 5-hydroxyheptanal
(B) 5-hydroxy-2-heptanone
(C) 6-hydroxy-3-heptanone
(D) 6-hydroxyheptanal
(E) 2-ethyl-5-methyltetrahydrofuran

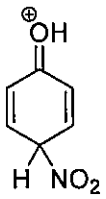
18. Which of the following are valid resonance structures for the intermediate species in the reaction shown below?

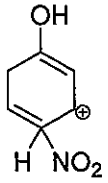
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(A) (i), (ii), (iii), (iv), (v), (vi)
(B) (ii), (iii), (iv)
(C) (ii), (iii), (v)
(D) (ii), (iii), (iv), (v)
(E) (i), (ii), (iii)

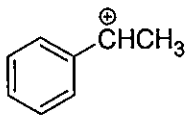
19. Arrange the following in order of decreasing base strength (strongest base first).

I. $CH_3CH_2O^-$ II. $CH_3\ddot{C}H_2^-$ III. NH_2^- IV. $HC\equiv C:^-$

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

20. Which of the following carbocations would most readily undergo a 1,2-hydride shift?

(A) $(CH_3)_3C^{\oplus}$

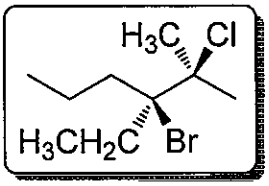
(B) 

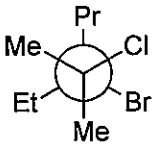
(C) $CH_3\overset{\oplus}{C}HC(CH_3)_3$

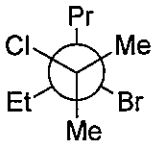
(D) $CH_3\overset{\oplus}{C}HCH(CH_3)_2$

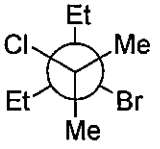
(E) $(CH_3)_2\overset{\oplus}{C}CH_2CH_3$

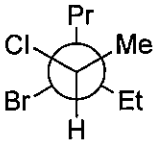
21. What is the correct Newman projection for the following molecule?

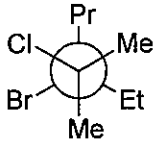


(A) 

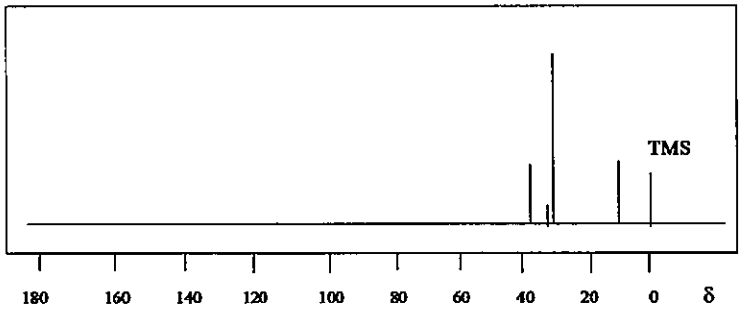
(B) 

(C) 

(D) 

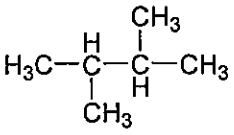
(E) 

22. Identify which one of the following isomers of C_6H_{14} has the ^{13}C NMR below.

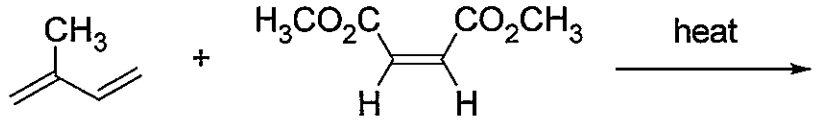


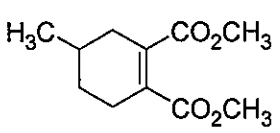
(A) $CH_3CH_2CH_2CH_2CH_2CH_3$ (B) $CH_3CH_2CH_2CH(CH_3)_2$

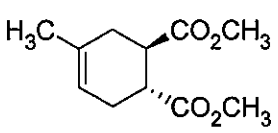
(C) $(CH_3)_2CHCH(CH_3)_2$ (D) $CH_3CH_2C(CH_3)_3$

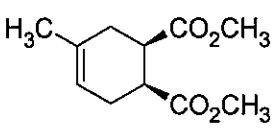
(E) 

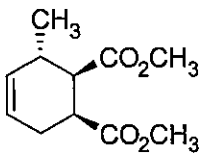
23. What is the product of the following Diels-Alder reaction?

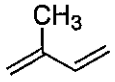


(A) 

(B) 

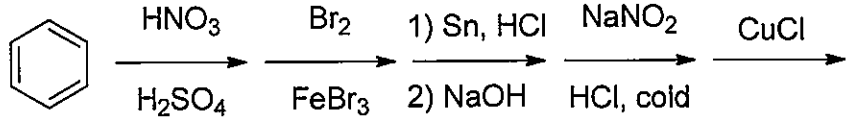
(C) 

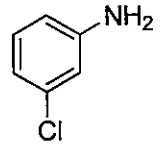
(D) 

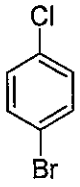
(E) 

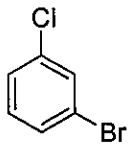
cannot undergo Diels-Alder reaction

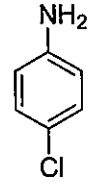
24. What is the major organic product from the sequence of reactions shown below?

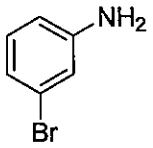


(A) 

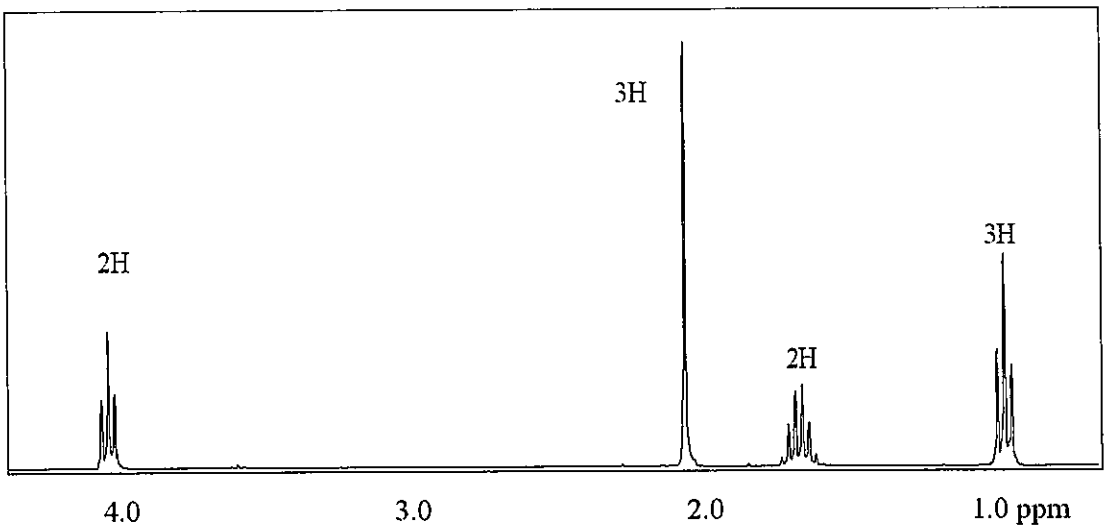
(B) 

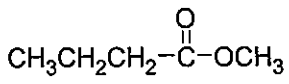
(C) 

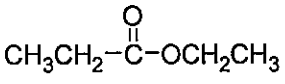
(D) 

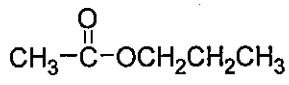
(E) 

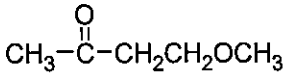
25. Which of the following compounds fits the proton NMR shown below?

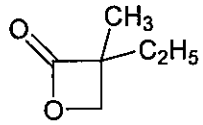


(A) 

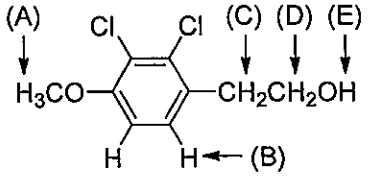
(B) 

(C) 

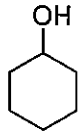
(D) 

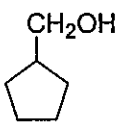
(E) 

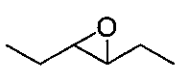
26. Which of the protons indicated will be observed as a doublet in the ^{1}H NMR spectrum of the molecule shown below?

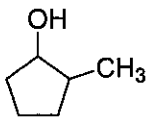


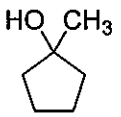
27. Compound **A**, $C_6H_{12}O$, is readily oxidized with $K_2Cr_2O_7$ in H_2SO_4/H_2O to give compound **B**, $C_6H_{10}O$. Compound **B** has four peaks in its ^{13}C NMR (broadband decoupled). Which one of the following fits the data for compound **A**?

(A) 

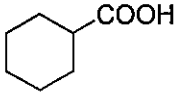
(B) 

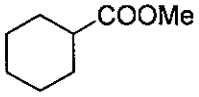
(C) 

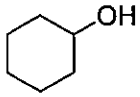
(D) 

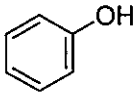
(E) 

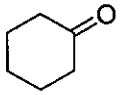
28. Rank the following compounds in order of increasing acidity:

(I) 

(II) 

(III) 

(IV) 

(V) 

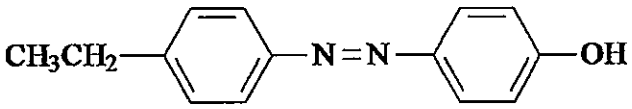
(A) (II), (III), (V), (IV), (I)
(B) (I), (IV), (III), (V), (II)
(C) (I), (IV), (III), (II), (V)
(D) (II), (V), (III), (IV), (I)
(E) (V), (II), (III), (IV), (I)

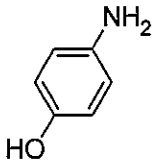
29. Which of the following reagents react with 2-butene by *syn* addition?

(i) Cl_2 (ii) Br_2 (iii) H_2 / Pt
(iv) OsO_4 (v) Br_2 / H_2O

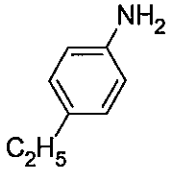
(A) (i), (ii) (B) (iii), (iv) (C) (iii), (iv), (v)
(D) (i), (ii), (v) (E) only (iii)

30. Which of the following would be the starting reagents needed to make the compound shown below?

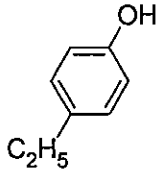




I



II



III

aniline

IV

phenol

V

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