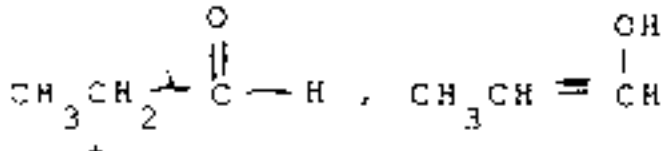
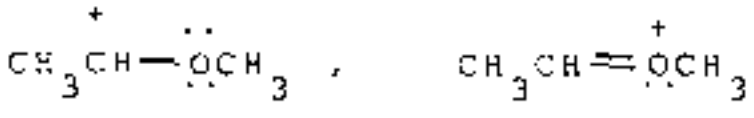
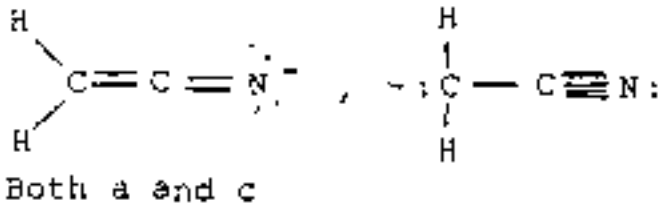
Part A

(一) (每題 1.5 分)

1. Which of the following choices represent(s) a pair of resonance structures?

A. 

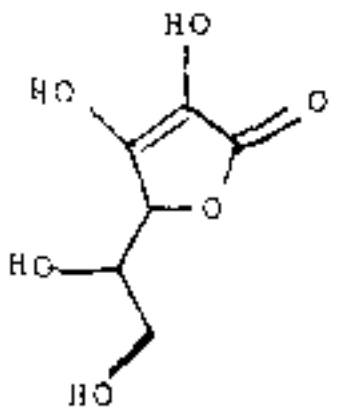
B. 

C. 

D. Both a and c

E. Both b and c

2. The structure of vitamin C is shown below. Which one of the following statements concerning this structure is not correct?



A. The molecule contains 2 pi bonds.

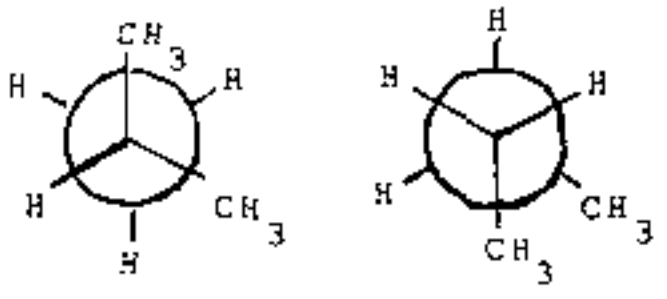
B. The molecule contains 1 sp^2 hybridized oxygen atom.

C. The molecule contains 3 sp^2 hybridized carbon atoms.

D. The molecule can be classified as an aldehyde.

E. The molecule contains more than one hydroxyl group.

3. The structures below are:



A. not isomers

B. conformational isomers

C. geometric isomers

D. structural isomers

E. both b and d

4. How do alkyl substituents stabilize a carbocationic center to which they are attached?

   A. Through an inductive removal of electron density from the cationic center.
   B. Through an inductive donation of electron density to the cationic center.
   C. Through hyperconjugation.
   D. Both a and c.
   E. Both b and c.

5. Which of the following species is the least nucleophilic?

   A. $(CH_3)_3CO^-$ **B.** H_2O **C.** $(CH_3)_3N$ **D.** BF_3 **E.** CN^-

6. Addition of Br_2 to (Z)-3-hexene 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

7. What two atomic orbitals or hybrid atomic orbitals overlap to form the C-O bond in ethanol?

   A. C sp^3 + O sp^3
   B. C sp^3 + O p
   C. C sp^2 + O sp^2
   D. C sp^2 + O sp^3
   E. none of the above

8. Which of the following alcohols will react most rapidly with the Lucas reagent (HCl, $ZnCl_2$)?

   A. $(CH_3)_3COH$
   B. $CH_3CH_2CH_2CH_2OH$
   C. $CH_3CHOHCH_2CH_3$
   D. $(CH_3)_2CHCH_2OH$

9. Absorption of what type electromagnetic radiation results in transitions among allowed vibrational motions?.

   A. X-rays
   B. radio waves
   C. microwaves
   D. ultraviolet light
   E. infrared light

10. The energy difference between the allowed spin states for an ^1H nucleus is _____ the strength of the external magnetic field in which it is placed.

A. independent of
B. directly proportional to
C. inversely proportional to
D. exponentially related to
E. logarithmically related to

11. What results when cis-2-butene is subjected to the following reaction sequence: (1) Cl_2, H_2O, (2) NaOH, (3) H_3O^+?

A. a meso epoxide
B. a 1:1 mixture of enantiomeric epoxides
C. a meso diol
D. a 1:1 mixture of enantiomeric diols
E. 2-butanol

12. Which of the species below is less basic than acetylide?

A. CH_3Li
B. CH_3ONa
C. NaOH
D. both b and c
E. all of the above

13. Absorption of UV-visible energy by a molecule results in:

A. vibrational transitions
B. electronic transitions
C. rotational transitions
D. nuclear transitions
E. none of the above

14. Which of the following compounds has the most signals in the noise-decoupled ^{13}C NMR spectrum?

A. o-dibromobenzene
B. m-dibromobenzene
C. p-dibromobenzene
D. 1,3,5-tribromobenzene
E. 1,2,3,4-tetrabromobenzene

15. In electrophilic aromatic substitution reactions the hydroxyl group is an o,p-director because:

A. it donates electron density to the ring by induction and destabilizes the meta sigma complex.
B. it donates electron density to the ring by resonance and stabilizes the ortho, para sigma complex.
C. it donates electron density to the ring by induction and stabilizes the ortho, para sigma complex.
D. it donates electron density to the ring by resonance and destabilizes the meta sigma complex.
E. it withdraws electron density from the ring by induction and destabilizes the meta sigma complex.

16. Consider the equilibrium of each of the carbonyl compounds with HCN to produce cyanohydrins. Which is the correct ranking of compounds in order of increasing Keq for this equilibrium?

A. H_2CO < cyclohexanone < CH_3CHO < 2-methylcyclohexanone
B. CH_3CHO < 2-methylcyclohexanone < cyclohexanone < H_2CO
C. cyclohexanone < 2-methylcyclohexanone < H_2CO < CH_3CHO
D. cyclohexanone < 2-methylcyclohexanone < CH_3CHO < H_2CO
E. 2-methylcyclohexanone < cyclohexanone < CH_3CHO < H_2CO

17. The strongest dichlorobutanoic acid is:

A. 2,2-dichlorobutanoic acid
B. 2,3-dichlorobutanoic acid
C. 3,3-dichlorobutanoic acid
D. 3,4-dichlorobutanoic acid
E. 4,4-dichlorobutanoic acid

18. $LiAl[OC(CH_3)_3]_3H$ will reduce an acid chloride to an:

A. alcohol B. alkane C. acid D. aldehyde E. acetal

19. Typically, amides will hydrolyze under _____ conditions than esters.

A. milder
B. more dilute
C. stronger
D. less vigorous
E. more saline

20. The relationship between ketones and their corresponding enols is one of:

A. isomers.
B. stereoisomers.
C. enantiomers.
D. diastereomers.
E. tautomers.

八十七學年度材料科學工程研究所(系)(所) 乙三 組碩士班研究生入學考試

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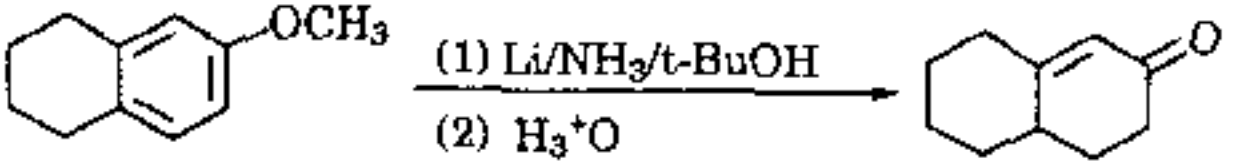
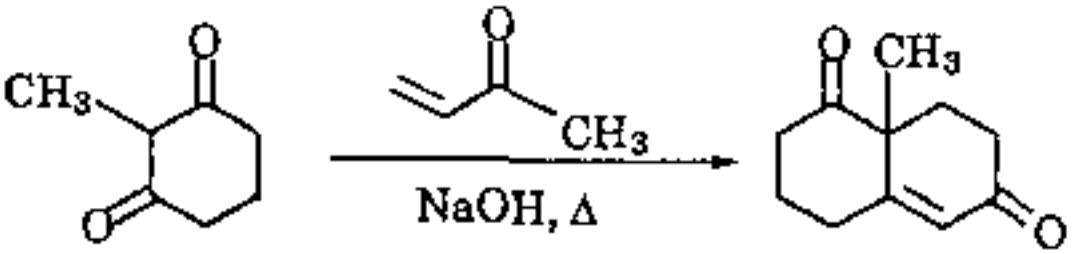
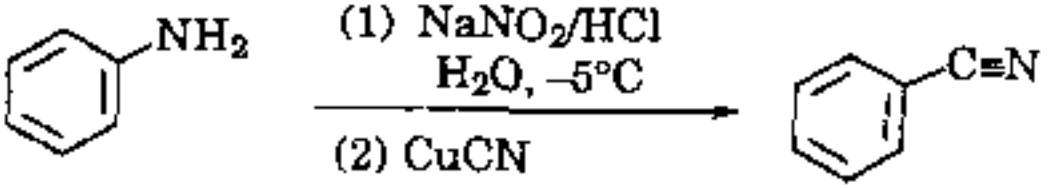
(二)

1. Write the stepwise reaction mechanisms for the following transformations: (5 points each)

(a) 

(b) 

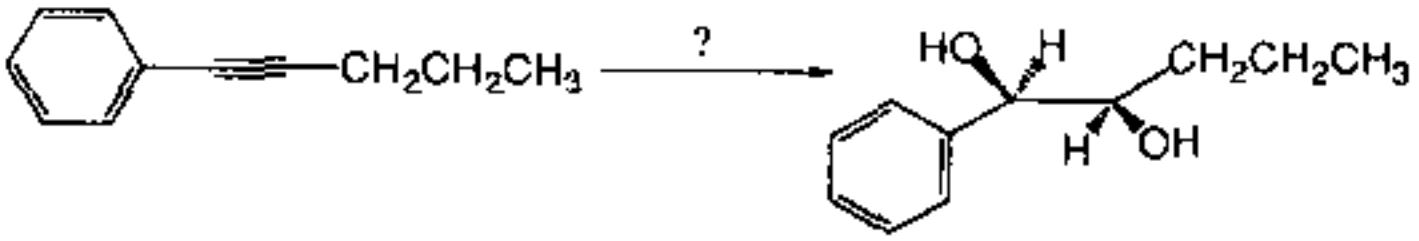
(c) 

(d) 

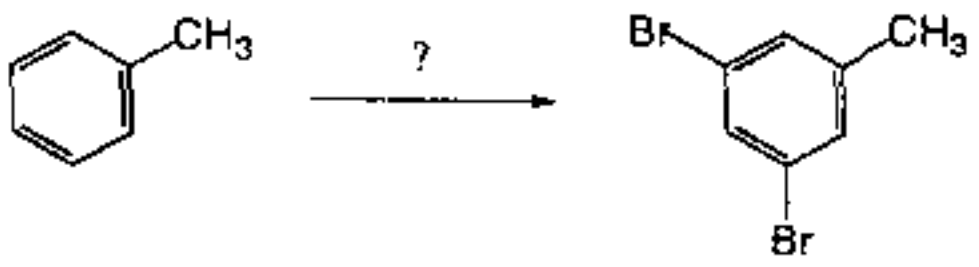
Part B

1. Provide necessary reagents to complete each of the following multistep synthetic transformations. Show the structure of synthetic intermediate for each synthetic step. (10%)

(a)

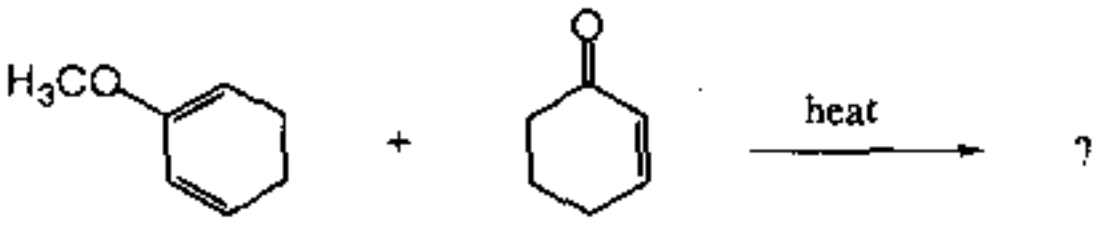


(b)

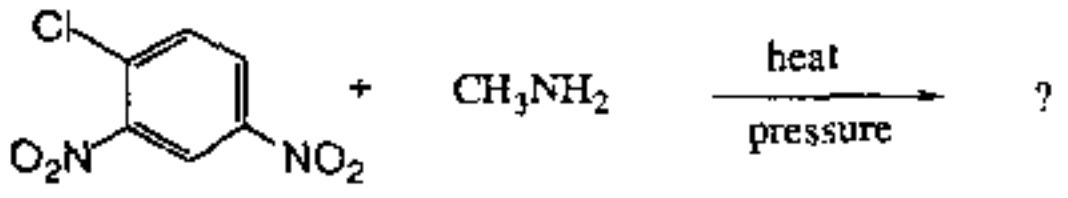


2. Predict the major product or provide necessary reagent(s) for each of the following reactions. Clearly indicate the stereochemistry of the product when necessary. (24%)

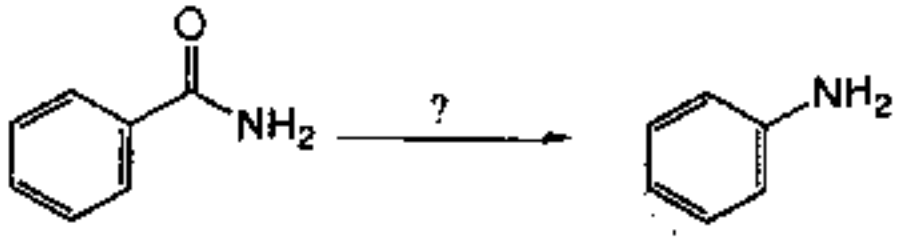
(a)



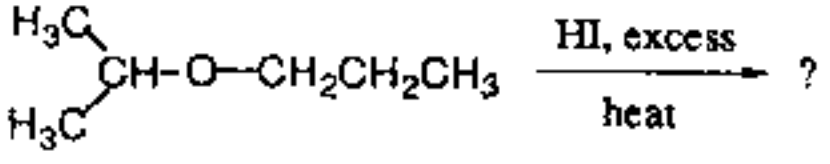
(b)



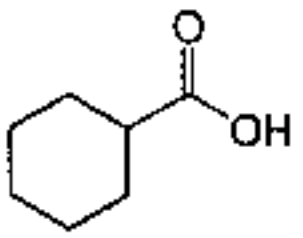
(c)



(d)

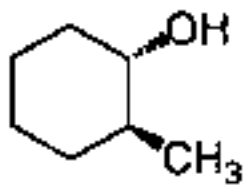


(e)

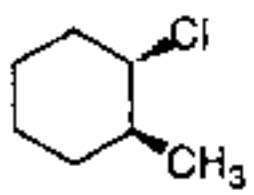


$\xrightarrow[\text{heat}]{I_2,\ Pb(OAc)_4}$?

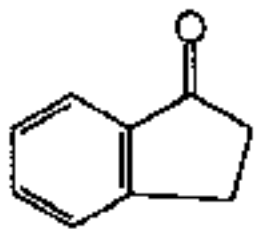
(f)



$\xrightarrow{?}$

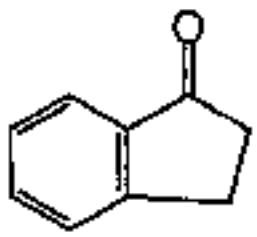


(g)



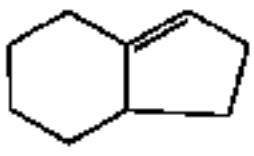
$\xrightarrow[HOCH_2CH_2OH,\ heat]{NH_2NH_2,\ KOH}$?

(h)



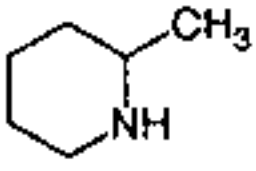
$\xrightarrow[2)\ LiAlH_4]{1)\ NH_2OH,\ CH_3COOH}$?

(i)



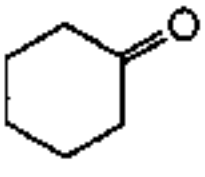
$\xrightarrow[2)\ H_2O_2,\ NaOH]{1)\ BH_3}$?

(j)



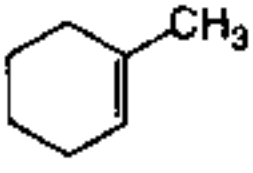
$\xrightarrow[2)\ \text{heat}]{1)\ CH_3\text{(excess)},\ Ag_2O}$?

(k)



$\xrightarrow[2)\ NaBH_3CN]{1)\ NH(CH_3)_2,\ H^+}$?

(l)



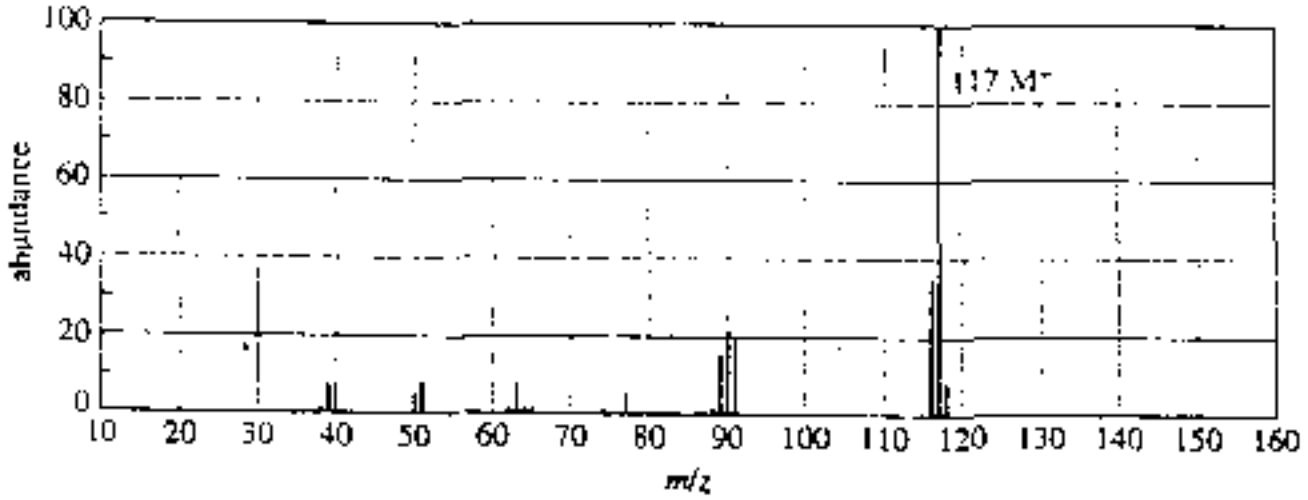
$\xrightarrow{HBr,\ \text{peroxide}}$?

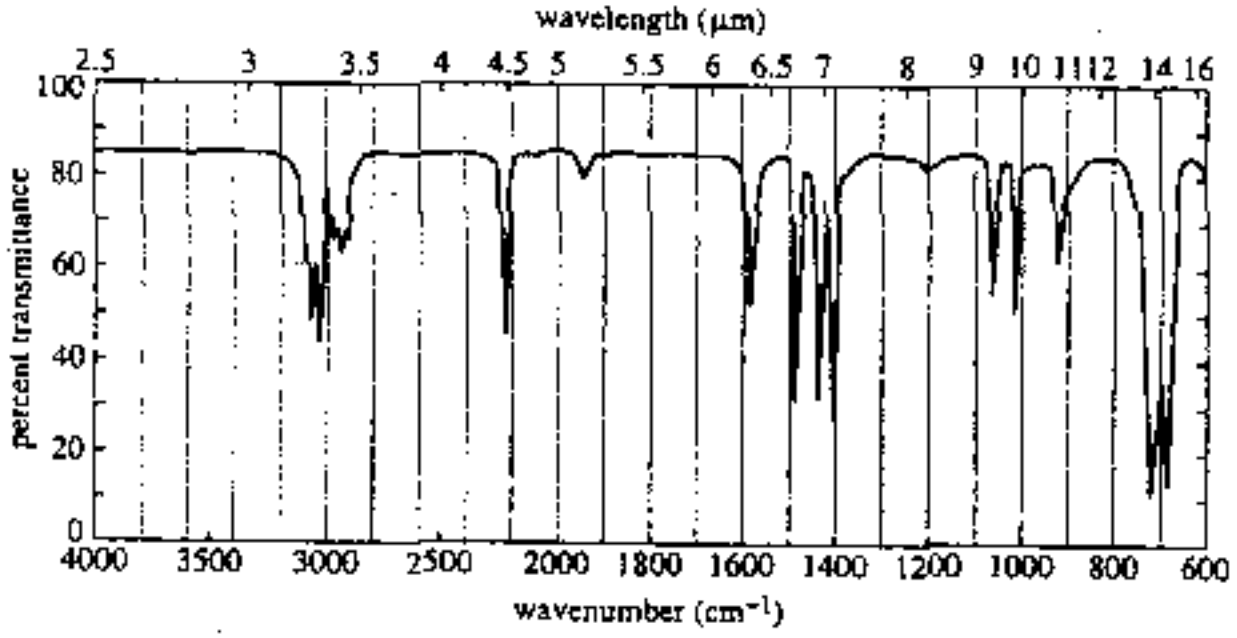
3. Deduce a possible structure for each of the following compounds with the given IR absorptions. Give details for your assignments. (6%)

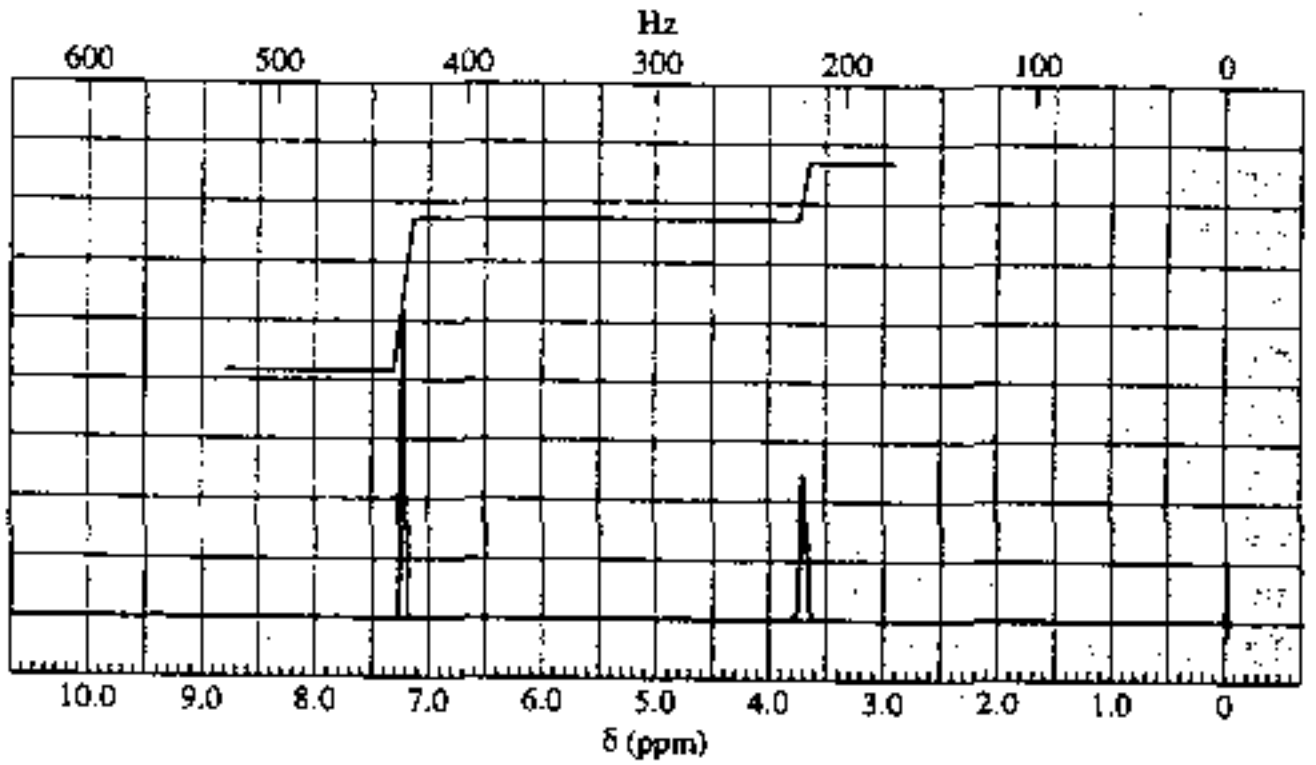
(a) C_3H_3Br: 3300, 2900, 2100 cm^{-1}.

(b) C_4H_8O: 3000, 2715, 1715 cm^{-1}.

4. Deduce a molecular structure for the compound with the given spectral data. List the structural characteristics which you can determine from that spectrum.(5%)







5. Deduce a molecular structure for the compound with the given spectral data. List the structural characteristics which you can determine from that spectrum.(5%)

Molecular formula C_8H_8O