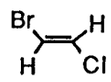
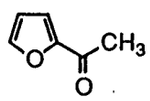
1. Please name the following compounds: (10 %)

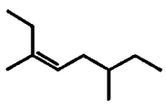
a.



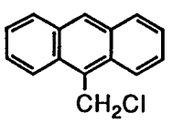
b.



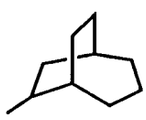
c.



d.

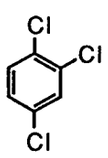


e.

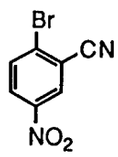


2. Which of the following benzene derivatives could be expected to react rapidly with sodium methoxide at 40 °C? (2 %, multiple choice)

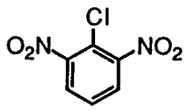
a.



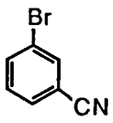
b.



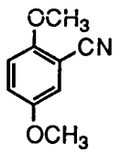
c.



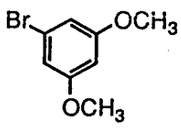
d.



e.

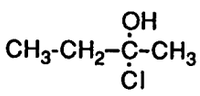


f.

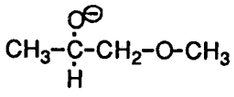


3.Which of the following compounds will be decomposed under the normal condition? (2 %, multiple choice)

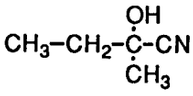
a.



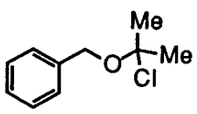
b.



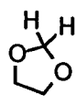
c.



d.

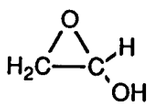


e.

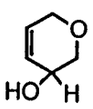


4. Which of the following species can undergo on acid-catalyzed decomposition? Predict the neutral products that could be formed .(6 %)

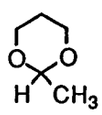
a.



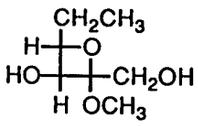
b.



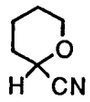
c.



d.

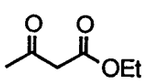


e.

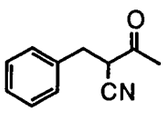


5. For each of the following structures, indicate hydrogens that will eventually be exchanged with deuterium if the species is dissolved in excess CH_3OD containing a trace of CH_3ONa. If more than one type of exchangeable hydrogen is present, order the types according to speed of exchange. (6 %)

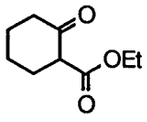
a.



b.



c.



6. Please give an example of each of the following name reactions. (4 %)
   a. Michael reaction
   b. Friedel-crafts reaction

7. A Substance of formula $C_{10}H_{12}O_2$ shows IR absorption at 1740 cm^{-1} and ^1H NMR absorption at 2.0 δ (singlet, area = 3), 2.9 δ (triplet, area = 2), 4.3 δ (triplet, area = 2) and 7.3 δ (multiple, area = 5). What is its structure? (4 %)

8. In each off the following pairs, predict which of the designated protons (H) occur at lower field. (6 %)

a.

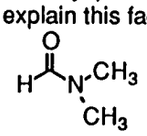
$CH_3CH_2C{\equiv}C\underline{H}$ vs $CH_3CH_2C{=}C\underline{H}_2$

b.

$CH_3CH_2{-}O\underline{H}$ vs $CH_3{-}\overset{\overset{O}{\|}}{C}{-}O\underline{H}$

c. $C\underline{H}_3{-}\overset{\overset{O}{\|}}{C}OCH_2C\underline{H}_3$

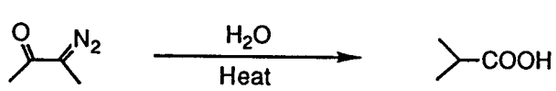
9. N,N-Dimethylformamide has two methyl peaks in ^1H NMR that means the two methyl groups are not equivalent, explain this fact? (4 %)



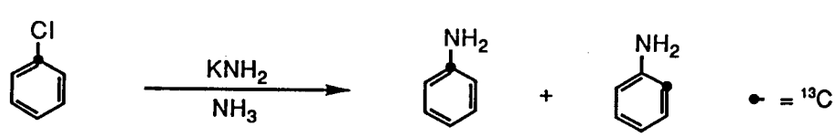
10. C_2H_6O has two structural isomers, please indicate two methods to distinguish them. (2 %)

11.Propose a reasonable mechanism for each of the following reactions. (16 %)

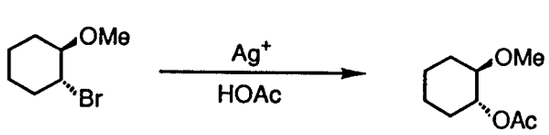
a.



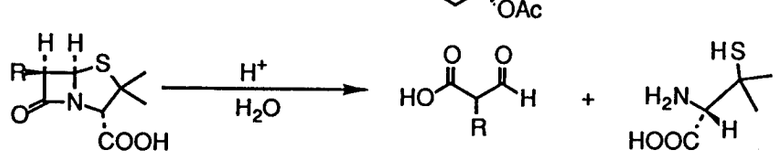
b.



c.



d.

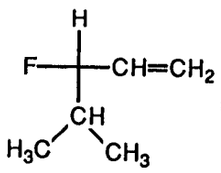


12. Predict the product of the reaction of meso-stilbene dibromide (CHBrPhCHBrPh) with potassium ethoxide (EtOK), why? (4 %)

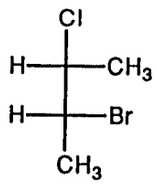
13. Explain why $PhCH_2CH_2CN$ undergoes electrophilic aromatic substitution at the ortho and para positions, but PhCH=CHCN undergoes electrophilic substitution at the meta position? (4 %)

14. Assign (R) or (S) designations to each of the following compounds: (4 %)

(1)



(2)



15. Give the structures of compounds **A-I.** (18 %)

(1)

$CH_3(CH_2)_7CH_2Br$ —(1) Ph_3P, (2) BuLi→ **A** ($C_{27}H_{33}P$) —$CH_3(CH_2)_{11}\overset{O}{\overset{\|}{C}}-CH_3$→

B ($C_{23}H_{46}$) —H_2/Pt→ **C** ($C_{23}H_{48}$)

(2)

$CH_2=CHCH_2OH$ —CrO_3/pyridine→ **D** (C_3H_4O) —$MeOH/H^+$→

E ($C_5H_{10}O_2$) —OsO_4→ **F** ($C_5H_{12}O_4$)

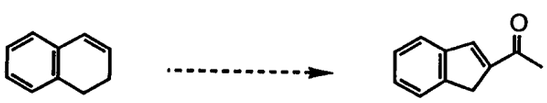
(3)

$EtO\overset{O}{\overset{\|}{C}}CH_2\overset{O}{\overset{\|}{C}}OEt$ —(1) NaOEt, (2) CH_3CH_2I (1 eq.)→ **G** ($C_9H_{16}O_4$) —(1) NaOEt, (2) $CH_3CH_2CH_2Br$ (1 eq.)→

H ($C_{12}H_{22}O_4$) —(1) OH^-/H_2O, (2) H_3O^+, (3) Heat→ **I** ($C_7H_{14}O_2$)

16. Show how each of the following transformation could be accomplished: (8 %)

(1)



(2)