I. Answer the following problems(20%):

( ) 1. Which reagent(s) would you use to carry out the following transformation? (a.) Br_2, heat, and light (b.) Cl_2, $FeCl_3$ (c) $KMnO_4$, OH^-, heat (then H_3O^+) (d) HNO_3/H_2SO_4 (e) SO_3/H_2SO_4

( ) 2. Which of the following procedures would not yield 3-pentanone as a major product?

a) $CH_3CH_2CN + CH_3CH_2MgBr \xrightarrow{H_3O^+}$

b) $CH_3CH_2COOH + 2\ CH_3CH_2Li \xrightarrow{H_2O}$

c) $CH_3CH_2CN + CH_3CH_2Li \xrightarrow{H_3O^+}$

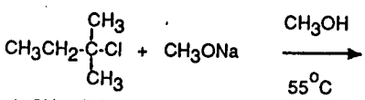
d) $CH_3CH_2COCl + (CH_3CH_2)_2CuLi \longrightarrow$

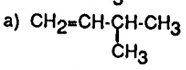
e) $CH_3CH_2COOH + CH_3CH_2MgBr \xrightarrow{H_3O^+}$

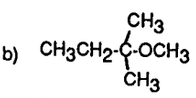
( ) 3. In the reaction of carbonyl compounds with $LiAlH_4$, the effective reducing species is:

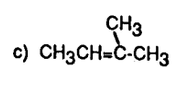
a) Li^+ b) Al^{+3} c) $AlH4^-$ d) AlH_3 e) H^-

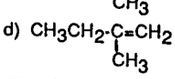
( ) 4. What would be the major product of the following reaction?



a) 

b) 

c) 

d) 

e) $CH_3CH_2CH(CH_3)_2$

( ) 5. Treating $(Me)_3C$-Cl with a mixture of H_2O and MeOH at room temperature would yield:

a) $CH_2=C(CH_3)_2$ b) $(CH_3)_3COH$ c) $(CH_3)_3COCH_3$ d) All of these e) None of these

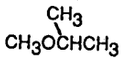
( ) 6. S_N1 reactions of the type, $Nu^- + RL \longrightarrow Nu\text{-}R + L^-$, are favored:

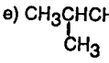
a) when tertiary substrates are used.
b) by using a high concentration of the nucleophile.
c) when L^- is a strong base.
d) by use of a non-polar solvent.
e) by none of the above.

( ) 7. How many ^{13}C signals would you expect from $C_6H_5OCH_3$?

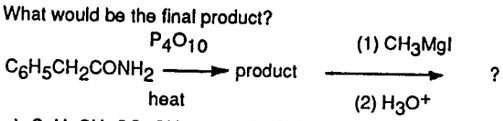
a) Four b) Two c) Three d) Seven e) Five

( ) 8. A compound with the molecular formula C4H10O gives a 1H NMR spectrum consisting only of a quartet centered at δ 3.5 and a triplet at δ 1.1. The most likely structure for the compound is:

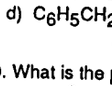
a) $(CH_3)_3C$-OH b)  c) $CH_3CH_2CH_2CH_2OH$ d) $CH_3CH_2OCH_2CH_3$

e) 

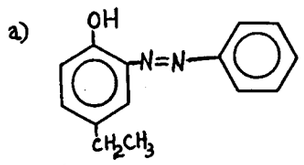
( ) 9. What would be the final product?

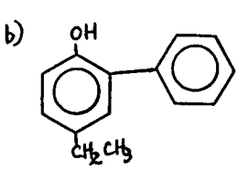


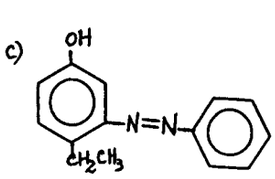
a) $C_6H_5CH_2CO_2CH_3$ b) $C_6H_5CH_2CH_2NHCH_3$ c) $C_6H_5CH_2COCH_3$

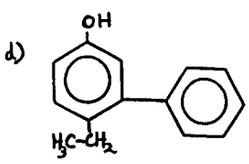
d)  e) $C_6H_5CH_2CH{=}NCH_3$

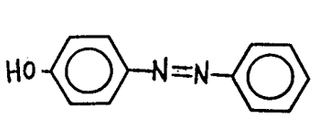
( ) 10. What is the principal product when aniline is treated with sodium nitrite and hydrochloric acid at 0-5°C and this mixture is added to *p*-ethylphenol?

a) 

b) 

c) 

d) 

e) 

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II. When a solution of 1,3-butadiene in CH_3OH is treated with chlorine, the products are $ClCH_2CH{=}CHCH_2OCH_3$ (30%) and $ClCH_2CH(OCH_3)CH{=}CH_2$ (70%). Write a mechanism that accounts for their formation. (6%)

III. What would be the major product formed in the Baeyer-Villiger oxidation of 3-methyl-2-butanone?(4%)

IV. a) Write resonance structures for the phthalimide anion that will account for the acidity of phthalimide. b) Would you expect phthalimide to be more or less acidic than benamide ? Why? (6%)

V. When acrolein reacts with hydrazine, the product is a dihydropyrazole:

CH_2=CHCHO + H_2N-NH_2 ⟶ 

Suggest a mechanism that explains this reaction. (6%)

VI. Propose a strcture for compound I whose ^{1}H NMR and IR spectra are given in the following Figs. (8%)

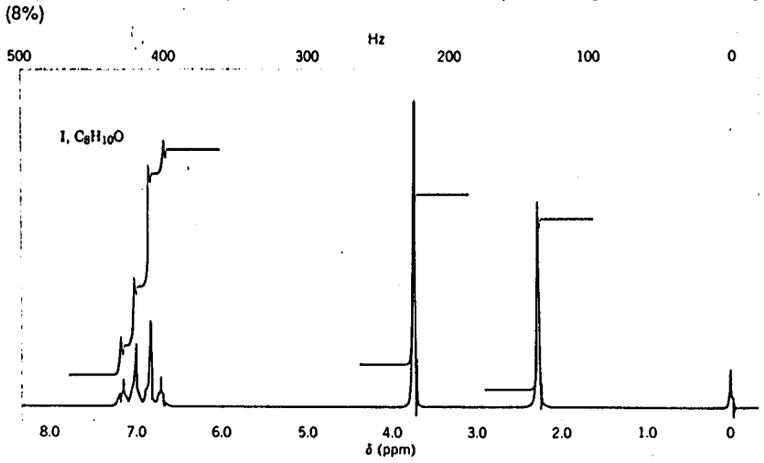


FIGURE 1. The ^{1}H NMR spectrum of compound I

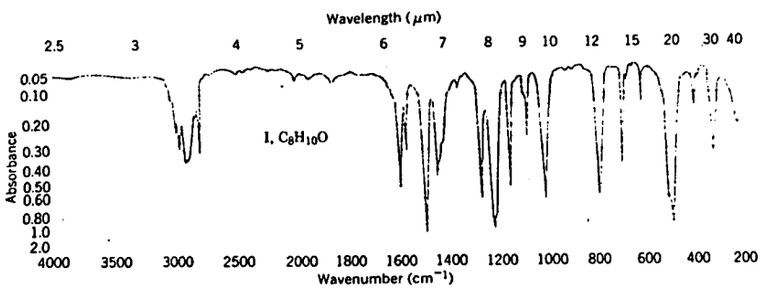
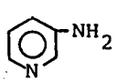
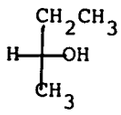
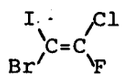
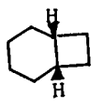


FIGURE 2. The IR spectrum of compound I

VII. Name (IUPAC system in English) or draw the structure of each of the following compounds or ion. (20%).

(a)  (b)  (c)  (d)  (e) 

(f) 18-crown-6 (g) DMF (h)trans-2-methylcyclohexanecarboxylic acid

(i) NBS (j)Tetrakis(1,1-dimethyethyl)tetrahedrane

VIII. For each of the following questions, assume that all measurements are made in 10-cm polarimeter sample containers. (4%).
(a) A solution of 0.4 g of optically active 2-butanol in 10 ml of water displays an optical rotation of -0.56°. What is its specific rotation?
(b) The specific rotation of sucrose is +66.4°. What would be the observed optical rotation containing 3 g of sucrose in 10 ml of water?

IX. Outline a simple chemical test that would distinguish between the members of each of the following compounds: 1,3-butadiene, butane, 1-butyne and 4-bromobutene. (8%).

X. Cyclohexane has two stable conformations; chair and boat form, which one is more stable? Please describe with Newman's projection. (6%).

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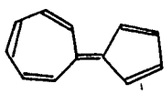
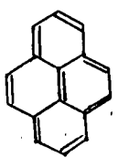
XI. Rank the members of each species below in the order of (1) basicity, (2) nucleophilicity, and (3) leaving-group ability. Briefly explain you answers. H_2O, HO^-, $CH_3CO_2^-$. (6%)

XII. Indicate whether each of the following compounds or ions would or would not be aromatic. Explaine you anser in each instance. (6%)

(a) 

(b) 

(c) 

(d) 

(e) 

(f)