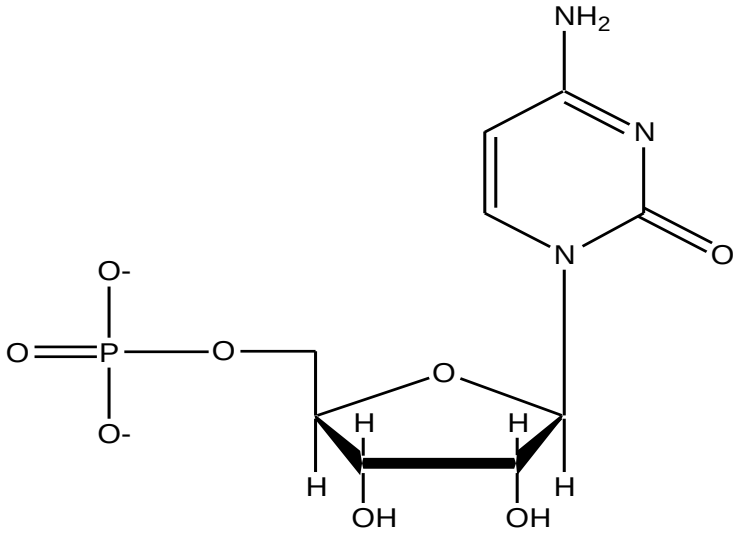
HOUSTON COMMUNITY COLLEGE SYSTEM

Departmental Final Examination
Organic Chemistry II
2425



ORGANIC CHEM 2425 Sample FINAL EXAM

DIRECTIONS- ***A periodic table is attached at the end of this exam. Please answer all questions in the space provided as completely and clearly as possible. Please show all your work for the writing portions of the exam.***

PART I- Multiple Choice (2 points each)

_____1. How many set of equivalent hydrogens are present in the ^{1}H NMR spectrum of 1- bromobutane?

A. 1 B. 2 C. 3 D. 4

_____2. Which of the following would give a ^{1}H NMR which consists of a 9 H singlet at δ 1.30 and 5 H singlet at δ 7.30?

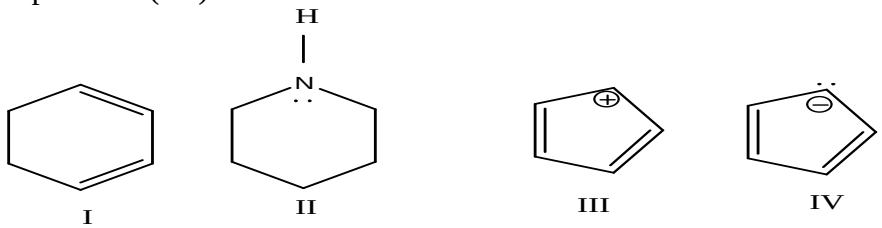
A. CH_3-C$_6$H$_4$-CH_2 –CH_2 – CH_3 B. CH_3 – CH_2 -C$_6$H$_4$-CH_2- CH_3

C. C$_6$H$_5$–C(CH_3)$_3$ D. C$_6$H$_5$-C$_6$H$_5$

_____3. A compound exhibits a strong, broad band in its IR spectrum centered about 3300 cm^{-1}. Which type compound is more likely to be?

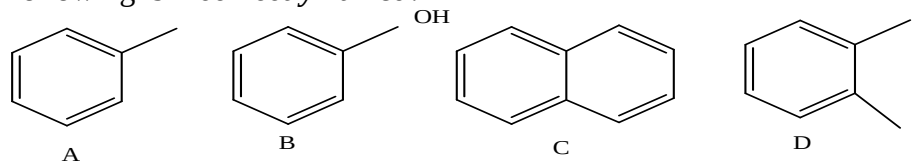
A. Ketone B. Alcohol C. Alkene D. Ether

_____4. Which species is (are) aromatic?



A. I only B. IV only C. II, III, and IV D. II

_____5. Which of the following is ***incorrectly*** named?



A. toluene B. phenol C. naphthalene D. m-xylene

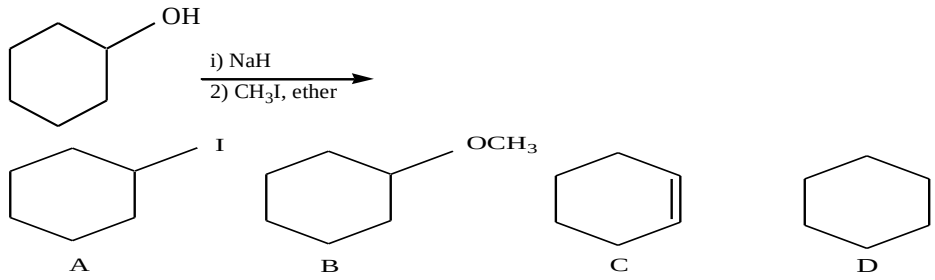
_____6. Which is the electrophile generated in the nitration of benzene by mixture of nitric acid and sulfuric acid?

A. NO^+ B. NO_2^+ C. HSO_4^+ D. NO_3^+

_____7. Which of these are ortho-para directors?

A. –NO_2 B. –OCH_2CH_3 C. –CO-NH_2 D. –CO-CH_2-CH_3

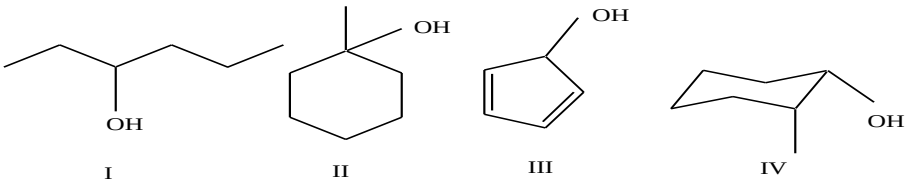
____8. Which is the major product from this reaction?



_____9. Which of the following has the ***lowest*** boiling point?

A. 1-pentanol B. 2-pentanol C. 3-pentanol D. t-butyl alcohol

_____10. Which compound(s) is(are) considered to be tertiary alcohol?



A. only II B. I, II C. only IV D. I, III

_____11. Which is the major initial pair of products when methylisopropyl ether is treated with HI?

A. methanol and isopropyl alcohol B. methanol and isopropyl iodide
C. methyl iodide and isopropyl alcohol D. methyl iodide and isopentyl iodide

_____12. Which of the following reagents is least likely to oxidize aldehydes?

A. Air B. PCC C. Tollen's reagent D. Chromic acid

_____13. Which of the following is Acetaldehyde?

A. $H-C(=O)-CH_3$ B. $H-C(=O)-H$

C. $CH_3-C(=O)-C(=O)-H$ D. $H-C(=O)-C(=O)-H$

____14. Which is the correct name for  $-CO-CH_3$

A. acetophenone B. benzophenone C. phenone D. phenyl ketone

_____15. Carboxylic acids have higher boiling points than alkenes of similar molecular weights. Which of the following best explains this observation?

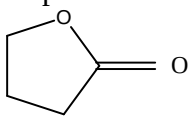
A. vanderwaals interaction B. hydrogen bonding
C. higher pKa values D. all of these

_____16. Which of the following is least acidic?

A. $CH_3 – CHCl–COOH$ B. $ClCH_2 –CH_2 – COOH$

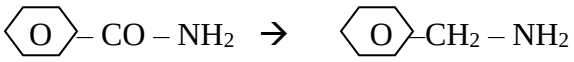
C. $CH_3 – CCl_2 – COOH$ D. $BrCH_2 – CH_2 – COOH$

_____17. What type compound is this?



A. Lactone B. Lactam C. anhydride D. Crown ether

_____18. What is the reagent for the following reaction?



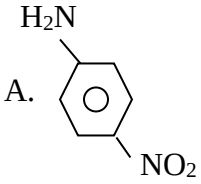
A. $Br_2/OH^-/H_2O$ B. $LiAlH_4/H_3O^+$ C. Zn/H_3O^+ D. $SOCl_2/H_3O^+$

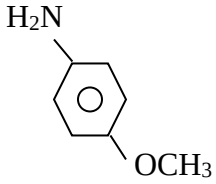
_____19. Which of theses is(are) a secondary amine(s) ?

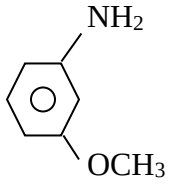
I. $(CH_3CH_2)_3N$ II. $(CH_3CH_2)_3\ C–NH_2$ III. $CH_3 – NH–CH_2CH_3$

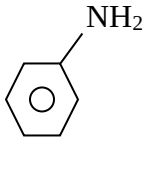
A. II and III B. II only C. III only D. none of these

_____20. Which of the following is the strongest base?

A. 

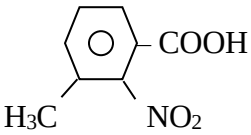
B. 

C. 

D. 

<u>PART II. Nomenclature and structures (2 points each)</u>

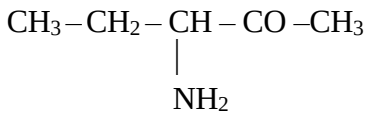
21. Give the correct IUPAC names for the following structures:

a) 

_____

b) $CH_2 = CH – OCH_3$

_____

c) 

_____

22. Give the correct structure for the following names :

a) 4–chloro–2,5–dinitrophenol

b) p–bromotoluene

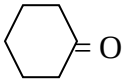
c) cis–4–methylcyclohexanol

PART III. Comparison: (2 points each)

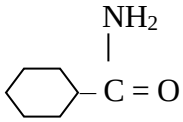
23. Identify (assign) the following as:

_____ I. Tautomer isomers(T) or geometrical isomers(G)

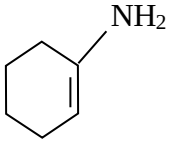
_____ II. Enol(E) or ketone(K)



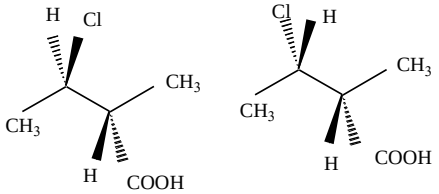
_____ III. Nitrile(N) or amide (A)



_____ IV. Enamine(E) or amine(A)



_____ V. Enantiomer (E) or Diastereomer(D)

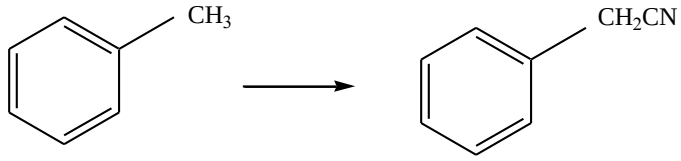


PART IV. Synthesis (3 points each)

24 . Show by a series of reactions how you could prepare the following compounds from the indicated starting compound. Be sure to clearly indicate the reagents used in each step.

I) Benzene → p-nitrobenzoic acid

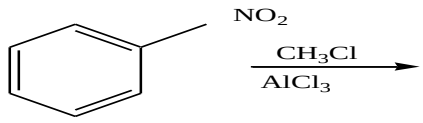
II)



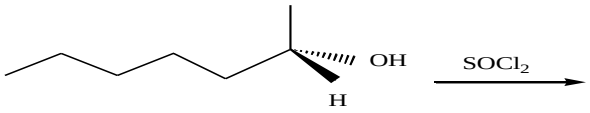
PART V. Reactions (2 points each)

25. Give the major organic product(s) of each of the following reactions. Please show all relevant stereochemistry.

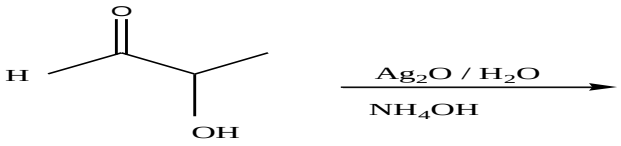
a)



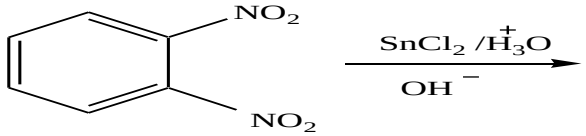
b)



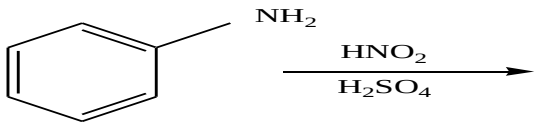
c)



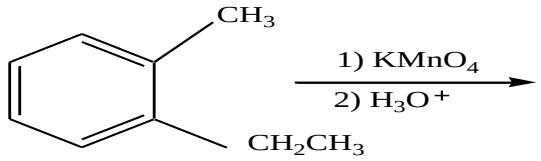
d)



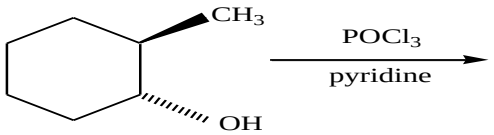
e)



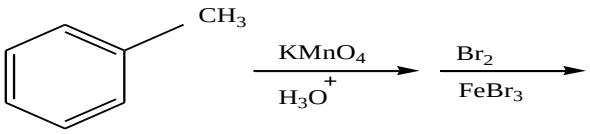
f)



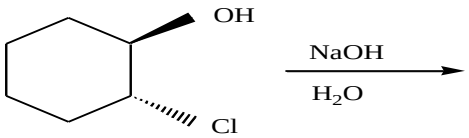
g)



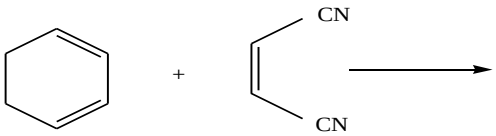
h)



i)



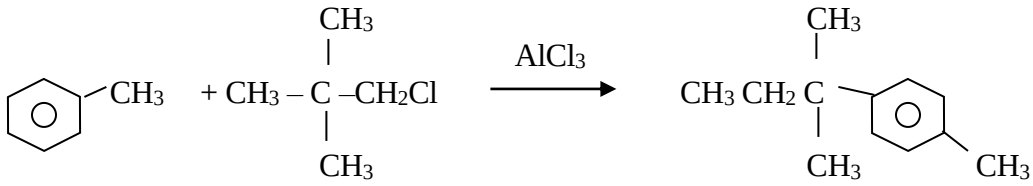
j)



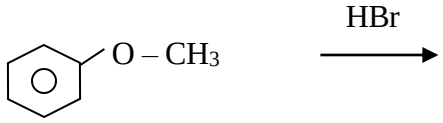
PART VI. Mechanisms (4 points)

26. For the following reaction, write a complete mechanism for reaction which adequately accounts for the formation of product. Show all intermediate structures and all electron flow using the curved arrow convention.

a)



b)

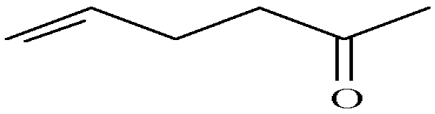


PART VII. Spectroscopy problems (8 points)

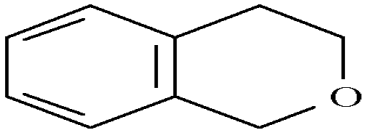
27.

a) Which structure (from the list below) fits the IR spectra shown below ?. (2 points)

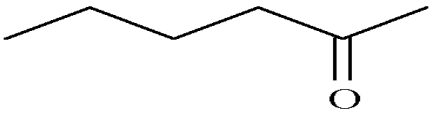
A.



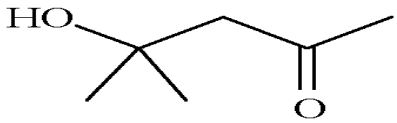
B.



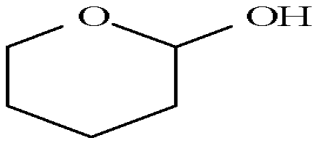
C.



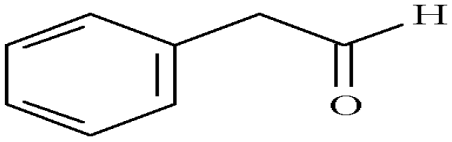
D.

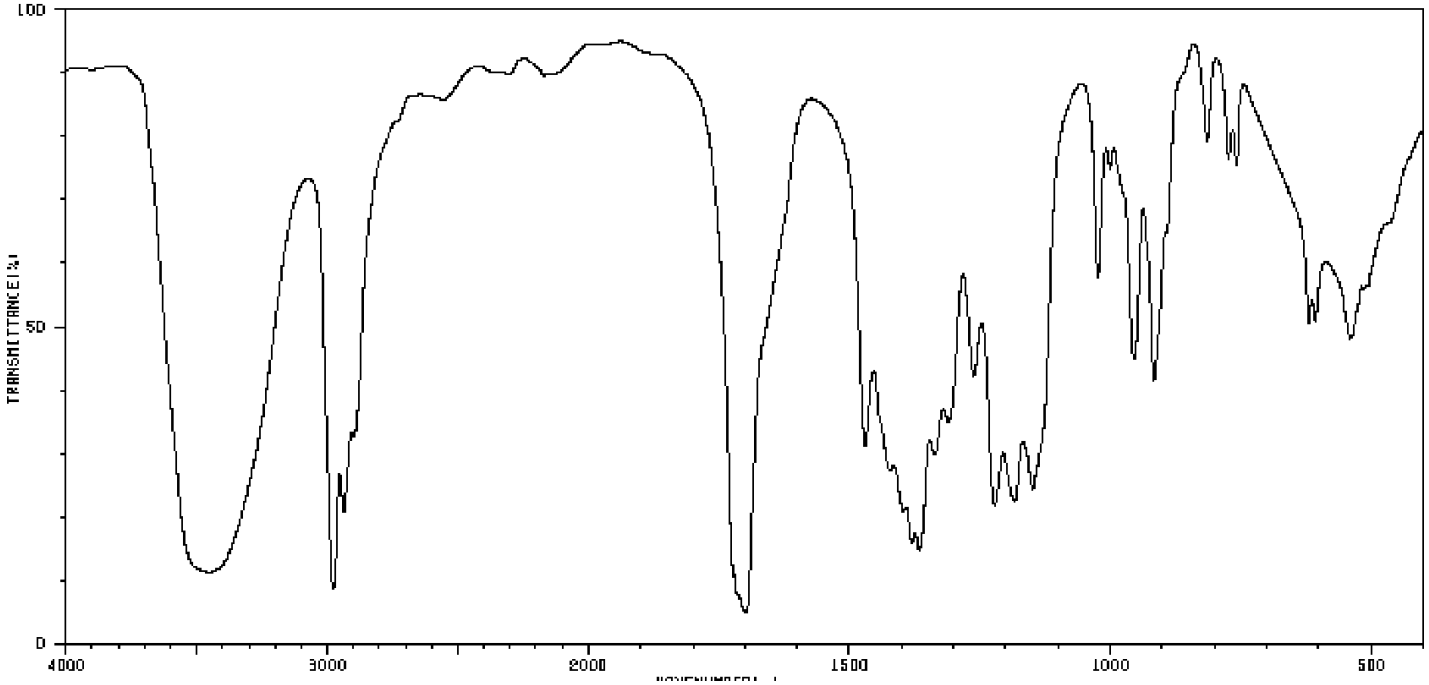


E.

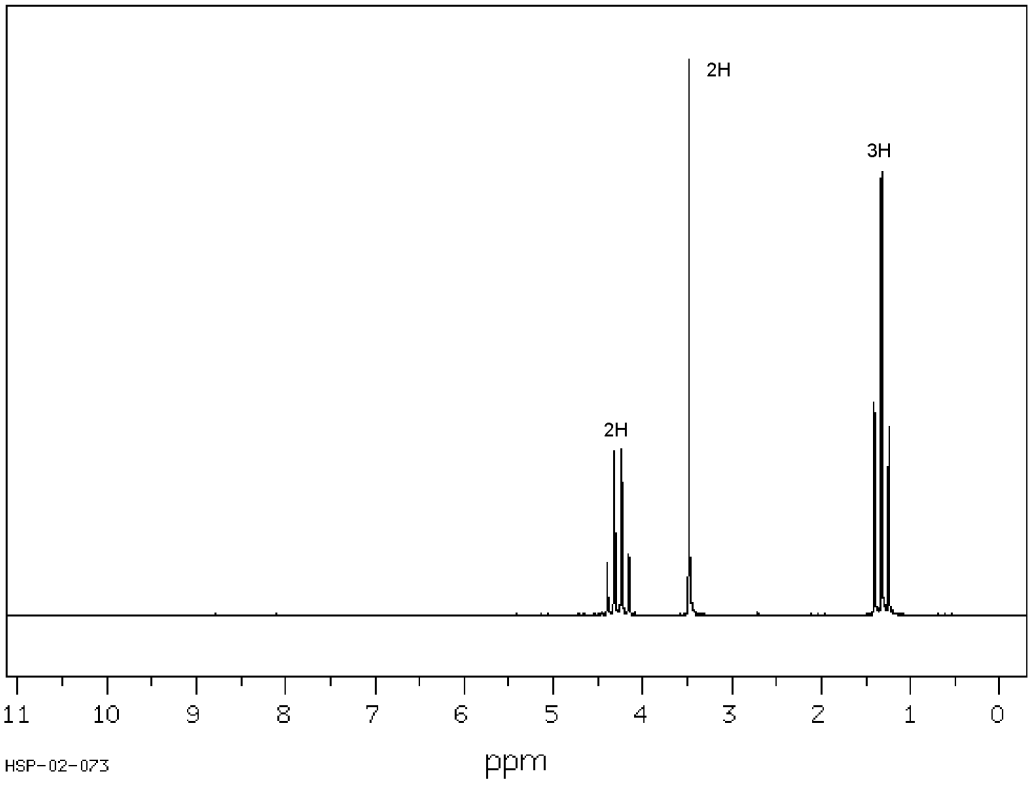


F.





b) The mass spectrum of a compound shows a molecular ion at *m/z* = 113, the IR spectrum has characteristic absorptions at 2270 and 1735 cm^{-1}, and the ^1H NMR spectrum shown below . (4 points)

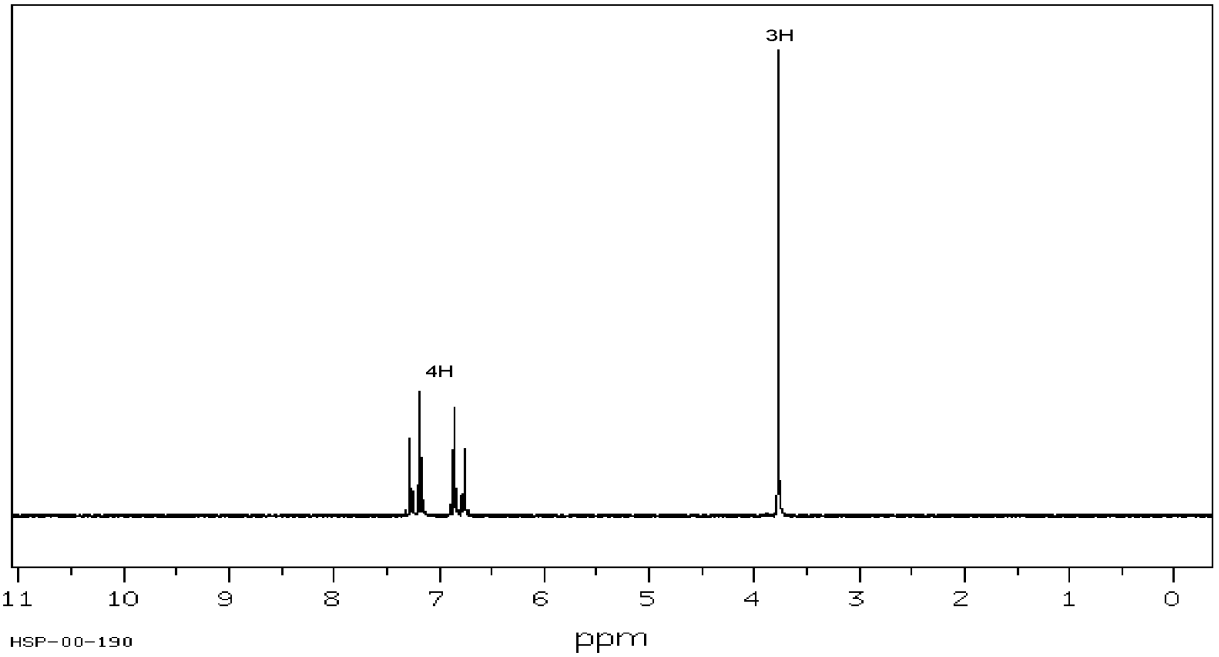


I. Based on the mass spectral data and the IR data, what functional groups are present in this compound?

II. How many types of nonequivalent protons are there in this molecule

III. Propose a structure for this compound

c) Consider the data below to answer the following questions. **C_8H_7ClO**; IR: 1690 cm^{-1} (2 points)



I) Calculate the degrees of unsaturation for this compound

II) Propose a structure for this compound

PART I- Multiple Choice (2 points each)

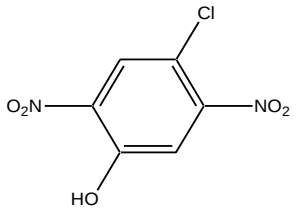
1. D, 2. C, 3. B, 4. B, 5. D, 6. B, 7. B, 8. B, 9. D, 10. A

11. C, 12. A, 13. A 14. A, 15. B, 16. D, 17. A, 18. B, 19. C, 20. B

PART II. Nomenclature and structures (2 points each)

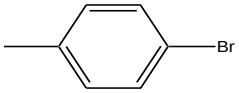
21. a) 3-Methyl-2-nitrobenzoic acid
    b) Methyl-vinyl-ether
    c) 3-Amino-4-methyl-2-hexanone

22. a)



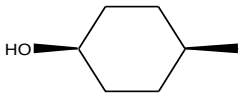
4-chloro-2,5-dinitrophenol

b)



p-bromotoluene

c)



cis-4-methylcyclohexanol

PART III. Comparison: (2 points each)

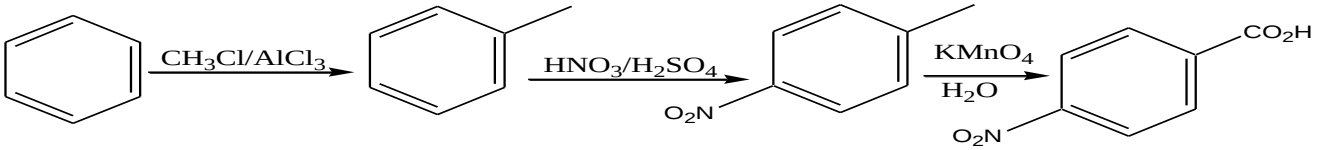
23.

I. T, II. K, III. A, IV. E, V. D

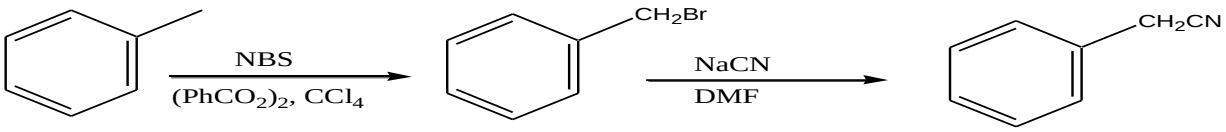
PART IV. Synthesis (3 points each)

24.

I.



II.

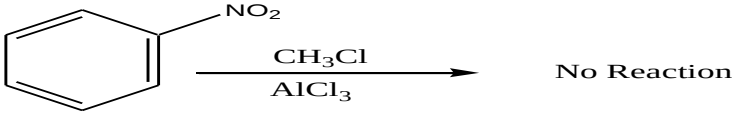


PART V. Reactions (2 points each)

25.

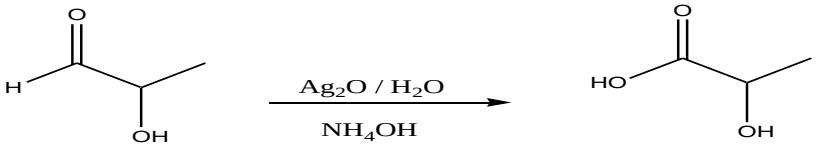
a)

b)



c)

d)



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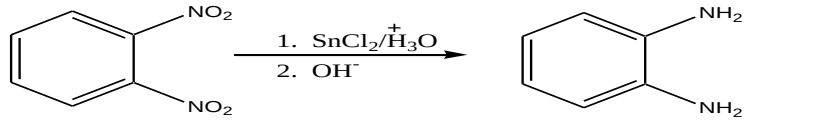

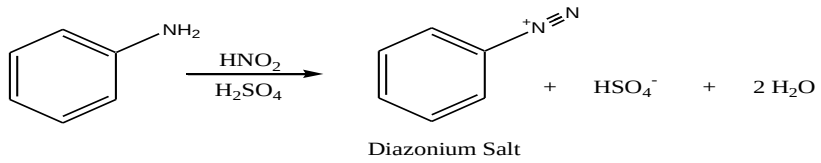

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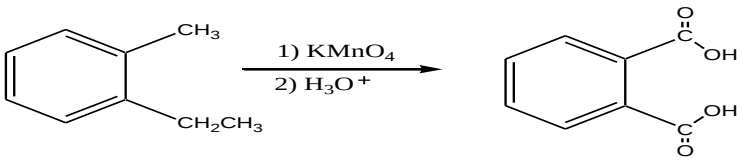

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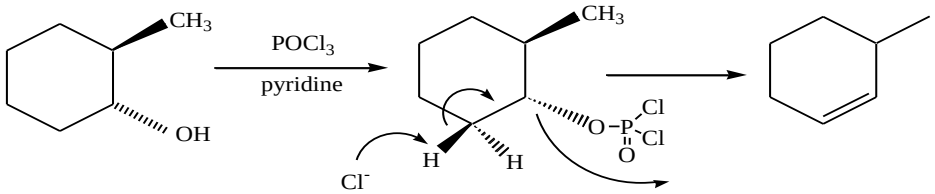

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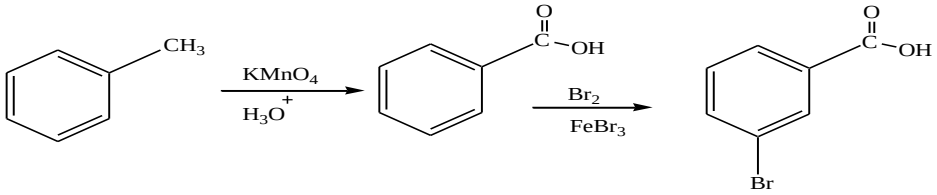
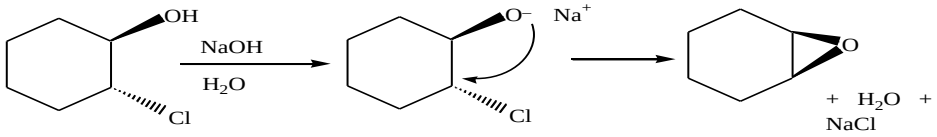


i)



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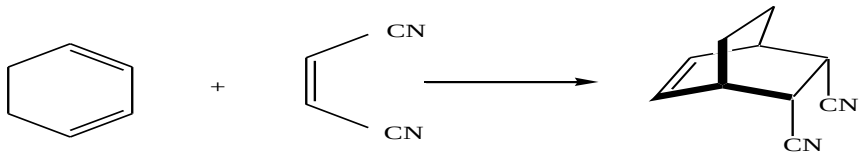
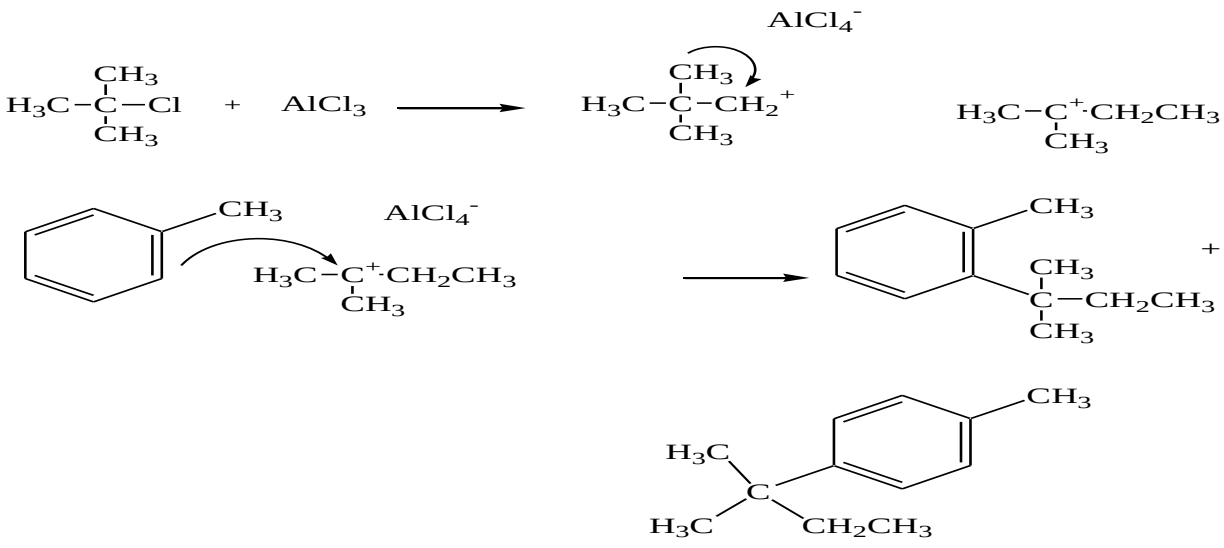


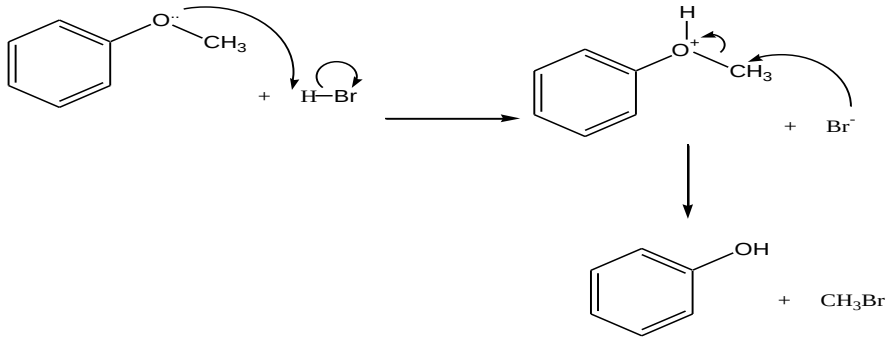
PART VI. Mechanisms (4 points)

26.

a)



b)



PART VII. Spectroscopy problems (8 points) a(2 points) b (4 points) c(2 points)

27.

a) D.

b) I. The parent pick at **113** indicates an **odd # of N** atoms in the compound. The IR absorption at **2270 cm^{-1}** indicates the presence of a **C≡N** group. The absorption at **1735 cm^{-1}** indicates the presence of a **C=O** group, probably an ester.

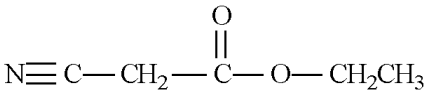
II. Three

III. Integration of the **singlet** at 3.5 δ shows the presence of **2 equivalent H**: a **-CH$_2$-**
The chemical shift **3.5 δ** indicates that this -CH$_2$- group is bonded to has an **electronegative atom or group**.

The **quartet signal** at 4.35 δ is attributed to a **-CH$_2$-** next to a -CH$_3$. δ at **4.35 δ** indicates that this **-CH$_2$-** is also bonded to by an **electronegative atom like O**.

The **triplet** signal at **1.3 δ** is attributed to **-CH$_3$** next to a -CH$_2$-.

Summary:
Presence of : **C≡N** group, **Ester** group, a singlet **-CH$_2$-** , and a **-CH$_2$-CH$_3$-** :



c) I. 1 + #C – [(#H + #Cl + #N) ÷ 2]
1+ 8 – [(7 + 1) ÷ 2] = 5 degree of unsaturation.

II. Integration of the **singlet** at 3.75δ shows the presence of **3 equivalent H**: (**-CH$_3$-)**

The 2 **doublet signals** at 6.75 & 7.25 δ are attributed to a 1-4-**disubstituted aromatic Ring:**