

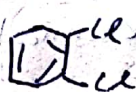
1. Answer the following questions: MCQ, True-False and fill in the blank. -10 Marks

a) Mass fragmentation pattern of $m/z = 15$ and 44 belongs to:

- (i) $-CH_3, CO_2$ (ii) $-NH_2, CO_2$
(iii) $-OH, CO_2$ (iv) $-CH_3, CH_2-CH_2-CH_3$

b) Electronic excitation possible in $C=O$ are _____.

c) ~~AF~~ NMR, RAMAN, UV-VIS are examples of Spectroscopy. True/False

d) Number of 1H NMR peaks in  are _____.

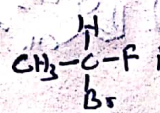
e) Frequency in the range of $10^{14} - 10^{16} \text{ Hz}$ cause _____ motion.

f) Purely Raman active compounds are IR inactive. True/False.

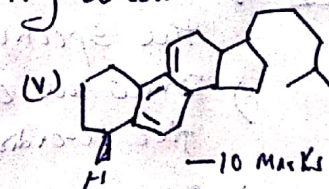
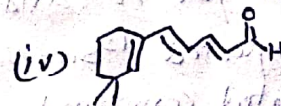
g) KBr is normally used to prepare sample in IR Spectroscopy. True/False

h) Chemical shift of $-CHO$ protons towards highly ~~shielded~~ ^{shielded} proton in 1H NMR. True/False

i) Organic acid ($-COOH$) gives FTIR absorption peak in two regions, _____ and _____ cm^{-1} .

j) Number of signals appear in ^{19}F NMR for compound  is _____.

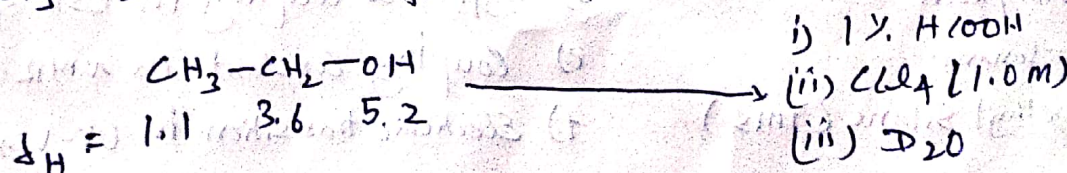
2. a) Calculate the λ_{max} for the following compounds using Woodward-Fieser Rule:



-10 Marks

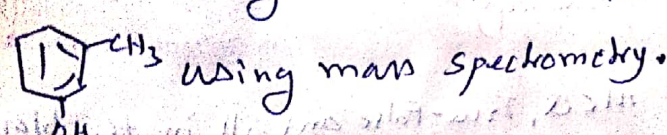
b) Explain the cause for the variation of 1H NMR spectra of CH_3-CH_2-OH under different conditions:

-10 Marks



Ans ①

3) a) what do you understand by "Nitrogen Rule" and write the most Probable fragmentation pattern/product of $\text{CH}_3\text{-CH}_2\text{-OCH}_3$ and



15 marks.

b) write a short note on McLafferty rearrangement. 5 marks

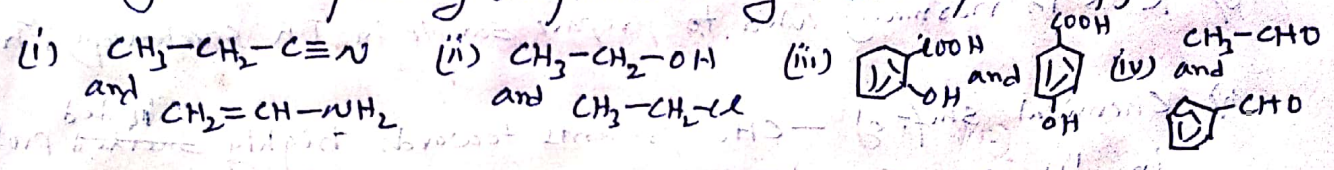
4) a) Propose the structure of compound A having the molecular formula $\text{C}_9\text{H}_{10}\text{O}$, molecular mass $m_z = 134$ and gave ^1H NMR results at - 15 marks
 $\delta_{\text{H}} = 7.40\text{--}7.05$ (5H, broad multiplet); 3.50 (2H, singlet); 2.0 (3H, singlet)

b) write a short note on chemical shifts in NMR spectroscopy. 5 marks

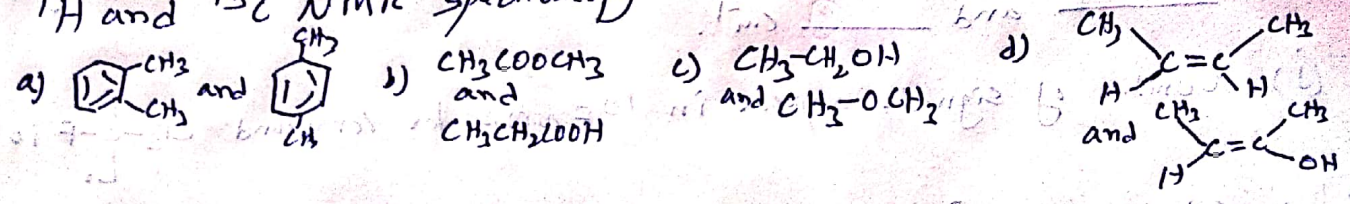
5) a) draw the expected ESR peaks/pattern of $\text{CH}_3\cdot$ and $\text{PH}_4\cdot$. 5 marks

b) Sketch the ^1H NMR pattern of 1,1,2-tribromoethane. 5 marks

c) Distinguish the following compounds using FTIR spectroscopy - 10 marks



6) How will you distinguish the following organic compounds using ^1H and ^{13}C NMR spectroscopy 20 marks



7) a) Describe the basic principles of Mossbauer spectroscopy and explain the spectrum for Fe^{2+} and Fe^{3+} - 10 marks

b) Draw the expected ^{119}Sn -NMR pattern of $(\text{CH}_3)_3\text{SnCl}$ and $(\text{CH}_3)_2\text{SnO}$, a five co-ordinated compound. - 5 marks

c) Discuss briefly the application of Resonance Raman spectroscopy for the study of active sites in metalloproteins. - 5 marks

8. Write short notes on: (any four)


- a) Metastable peak
- b) Fermi resonance
- c) Tetramethylsilane (TMS)
- d) Hyperfine coupling in ESR spectroscopy
- e) Coupling constant in NMR spectroscopy
- f) Electronic transition in UV-Vis spectroscopy

Answer any Five Questions in which Q. No-1 is compulsory.

1. Explain the reason of following questions: MCQ, True-False and Fill in the blanks. 11 x 10 Marks

a) NMR, FTIR, UV are examples of spectroscopy / spectrometry technique. Choose correct answer.

b) Purely Raman active compounds are IR active / inactive. Choose correct answer.

c) Number of ^1H NMR peaks in  in ____.

d) Chemical shift of $-\text{CH}_3$ ^{present} towards highly shielded / deshielded proton in ^1H NMR.

e) Organic acid group ($-\text{COOH}$) gives FTIR peak in two region ____ and ____ cm^{-1} .

f) For FTIR analysis, samples are prepared in KBr / ~~NaCl~~ H_2O . Which one is correct option.

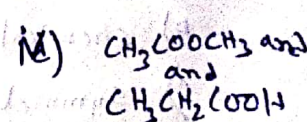
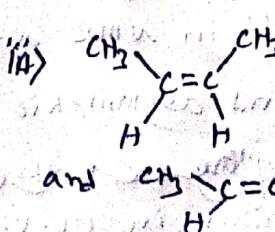
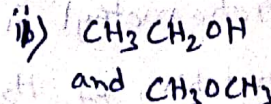
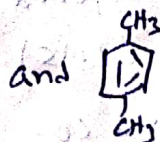
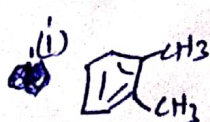
g) The range of frequency from 10^{12} to 10^{14} Hz belongs to which spectroscopy?

h) $\text{CH}_3-\underset{\text{Br}}{\underset{|}{\text{C}}}-\text{F}$ gives ____ number of signals in ^{19}F NMR.

i) Electronic excitation possible in $\text{C}=\text{C}$ are ____.

j) $m/z = 15$ and 44 represents the formation of ____ and ____ ion.

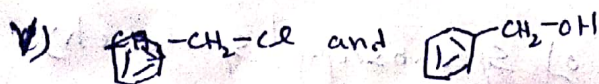
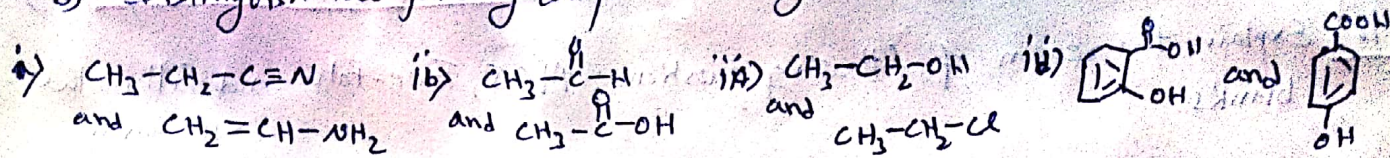
2. How will you distinguish the following organic compounds using ^1H and ^{13}C NMR spectroscopy 20 Marks




2
Bij

3. a) Draw the expected ESR peaks/patterns of CH_3^\bullet and PH_4^\bullet . — 5 marks

b) Distinguish the following compounds using FTIR Spectroscopy — 15 marks



4. a) What do you understand by "Nitrogen Rule" and write the most probable fragmentation pattern of $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_3$ and  using mass spectrometry technique — 15 marks

b) Write a short note on McLafferty rearrangement. — 5 marks

5. a) What do you understand by nuclear relaxation and what are the factors which affect nuclear relaxation. Describe the hyperfine coupling in ESR spectroscopy (10 marks)

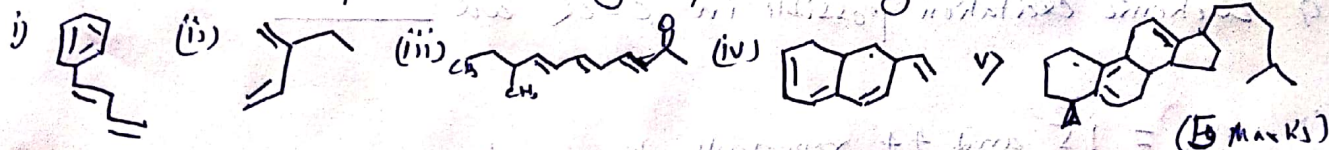
b) Draw the expected ^{51}V NMR pattern for five coordinated $(\text{CH}_3)_3\text{SnClSO}(\text{CH}_3)_2$ — 5 marks

c) Discuss briefly the application of Raman spectroscopy for the study of active sites of metalloproteins. — 5 marks

6. a) Propose the structure of compound A having the molecular formula $\text{C}_9\text{H}_{10}\text{O}$, molecular mass, $m/z = 134$ and gave ^1H NMR peak at — (15 marks)
 $\delta_{\text{H}} = 7.40-7.05$ (5H, broad multiplet); 3.50 (2H, singlet); 2.0 (3H, singlet)

b) Write a short note on metastable peak in mass spectrometry. — 5 marks

7. a) Calculate the λ_{max} for the following compounds using Woodward-Fieser Rule



b) In what respect ^1H NMR is different from ^{13}C NMR spectroscopy — 5 marks

c) Explain the cause for the variation of ^1H NMR spectra of $\text{CH}_3\text{CH}_2\text{OH}$ under different conditions.



8. Write a short notes on: — (20 marks)

a) Mössbauer spectra of Fe^{3+} and Fe^{2+} in chemical compound

b) chemical shift in NMR and Tetramethyl silane (TMS)

c) Symmetric and asymmetric stretching of H_2O and CO_2

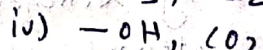
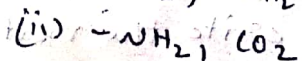
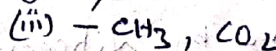
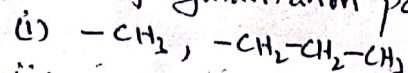
d) Hyperfine coupling in ESR spectroscopy

e) Electronic transition in UV-Vis spectroscopy.

Application of Spectroscopy

1. Answer the following questions: MCQ, True-False and fill in the blanks
1 x 10 marks

a) Mass fragmentation pattern of $m/z = 15$ and 44 belongs to:



b) Number of signals appear in ^{19}F NMR for compound $CH_3-\overset{H}{\underset{Br}{\underset{HO}{C}}}-F$ is _____

c) Chemical shift of $-COOH$ is higher than 9. True/False

d) Electronic excitation possible in $-C\equiv NH_2$ are _____

e) Purely Raman active compounds are IR active. True/False

f) KBr and Nujol is always used to prepare sample for _____ Spectroscopy.

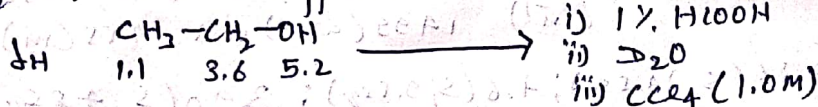
g) Frequency in the range of $10^{12} - 10^{14} \text{ Hz}$ represents _____ Spectroscopy.

h) Number of 1H NMR peaks in $\text{C}_6\text{H}_5\text{COOH}$ is _____

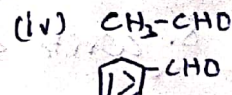
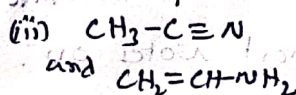
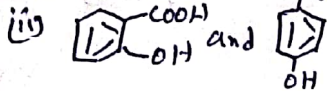
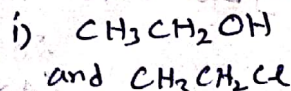
i) Carbonyl ($C=O$) stretching frequency in FTIR are in the range _____ cm^{-1} .

j) UV-Vis, FTIR and NMR are examples of Spectroscopy. True/False

2. a) Explain the cause for the variation of 1H NMR spectra of CH_3-CH_2-OH under different conditions! 10 marks



b) Distinguish the following compounds using FTIR Spectroscopy 10 marks

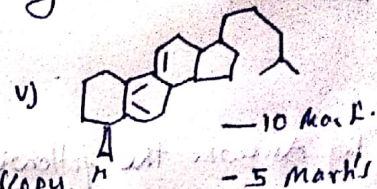
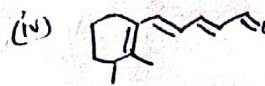
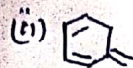
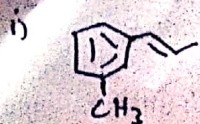


3. a) Describe the basic principles of Mössbauer spectroscopy and explain the spectrum for Fe^{2+} and Fe^{3+} . 10 marks

b) Draw the expected ESR peaks/pattern of CH_3^{\bullet} and $^iP\text{H}_4$ 5 marks

c) Write a short note on metastable peak. 5 marks

4. a) Calculate the λ_{max} for the following compounds using Woodward-Fieser rule!



b) Write a note on chemical shift in NMR spectroscopy.

c) In what respect 1H and ^{13}C NMR are different.

-5 Marks

5. a) What do you understand by "Nitrogen Rule" and write the most probable fragmentation pattern/product of $CH_3-CH_2-OCH_3$ and

15 Marks

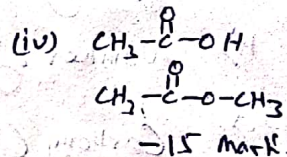
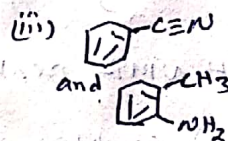
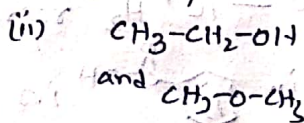
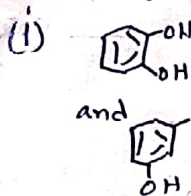
b) Write short note on McLafferty rearrangement.

5 Marks

6. a) Draw the expected ^{13}Sn -NMR pattern of five coordinated compound $(CH_3)_3SnCl(C(CH_3)_2SO_2)$.

5 Marks

b) Distinguish the following compounds using 1H and ^{13}C NMR spectroscopy.



-15 Marks

7. a) An organic compound with molecular weight 108 (M_r) is not acidic in nature but can be easily oxidized to a crystalline compound (melting point = $122^\circ C$). It gives the following spectral data: -15 Marks

UV = λ_{max} 255 nm ; IR : 3402 (s,b), 3065 (w), 2288 (m).
(ii) 1499 (w,sh) and 1455 (m)

NMR : 7.26 (s, 2H, 5.5ppm); 4.6 (s, 2H, 3.5ppm); 3.90 (s, 4H, 2.5ppm)

δH derive the likely structure of compound A

b) Sketch the 1H NMR pattern of 2,2-dimethylbut-1-ol. -5 Marks

8. Write short notes on:

20 Marks
(4x5)

a) Resonance Raman Spectroscopy for the study of active sites in metalloprotein

b) Shielding and deshielding phenomena in NMR.

c) Symmetric and asymmetric stretching of H_2O and CO_2

d) Electronic Transition in UV-vis spectroscopy.

e) Hyperfine coupling in ESR spectroscopy

27