No. of Printed Pages : 3

# RCH-002

## M. Phil./Ph. D. IN CHEMISTRY
## (MPHILCHEM/PHDCHEM)
## Term-End Examination
## June, 2023

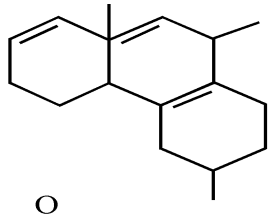
### RCH-002 : ANALYTICAL TECHNIQUES IN CHEMISTRY–I

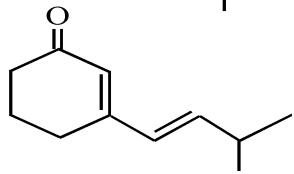
*Time : 3 Hours* *Maximum Marks : 100*

***Note :*** *Answer all the questions given below.*

1. Discuss electronic transitions in organic and inorganic molecules. Write the selection rules for UV-Vis spectroscopy. 10

2. Predict $\lambda_{max}$ for the following compounds using Woodward-Fieser rules : 10

(a) 

(b) 

3. Discuss the factors affecting intensity and shape of IR signals. 10

4. Match the names of the compounds from the list *a*, *b*, *c*, *d*, *e* with their correct IR spectrum 1, 2, 3, 4, 5 : 10

| List of Compounds | | IR Spectra |
|---|---|---|
| (a) Butylacetate | (1) | Attached Fig. (1) |
| (b) Butyramide | (2) | Attached Fig. (2) |
| (c) Isobutylamine | (3) | Attached Fig. (3) |
| (d) Lauric acid | (4) | Attached Fig. (4) |
| (e) Sodium propionate | (5) | Attached Fig. (5) |

5. What is meant by spin-spin coupling of protons ? What area the requirements for the coupling to occur between two protons ? 10

6. What is meant by offset in NMR spectrum ? Explain. 10

7. Explain nuclear overhauser effect. Taking suitable examples, discuss the advantages of 2D NOESY and 2D ROESY experiments. 10

8. Determine the structure of compound having molecular formula $C_5H_{10}O$ using $^1H$, $^{13}C$ and DEPT NMR spectra given (attached). 10

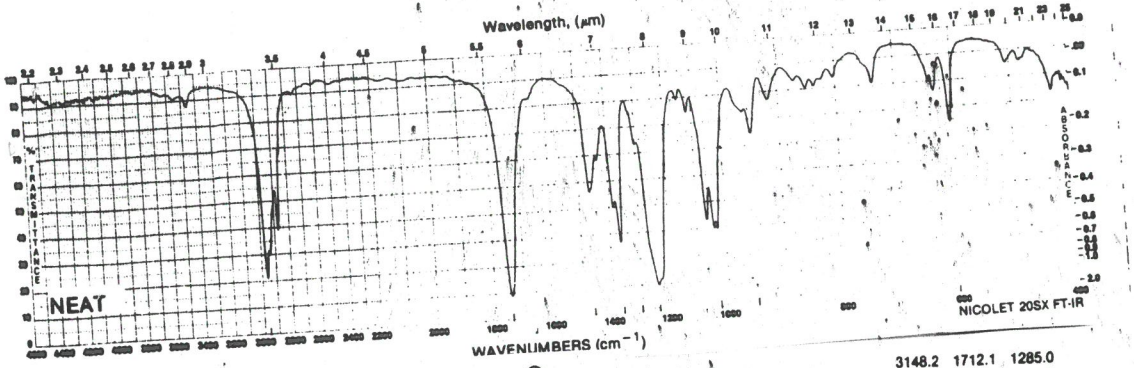
9. What are different techniques used in mass spectrometry to produce molecular ions ? Discuss any *two* techniques in some detail. 10

10. Predict a structure which is consistent with each set of proton NMR data and IR data : 10

| | | S/Splitting | Integration | IR/$cm^{-1}$ |
|---|---|---|---|---|
| (a) | $C_{15}H_{14}O$ | 2.20 (s) | 3:1:10 | 1720 (strong) |
| | | 5.08 (s) | | |
| | | 7.28 (m) | | |
| (b) | $C_5H_{14}O$ | 1.10 (d) | 6:3:1 | 1720 (strong) |
| | | 2.10 (s) | | |
| | | 2.50 (sep.) | | |

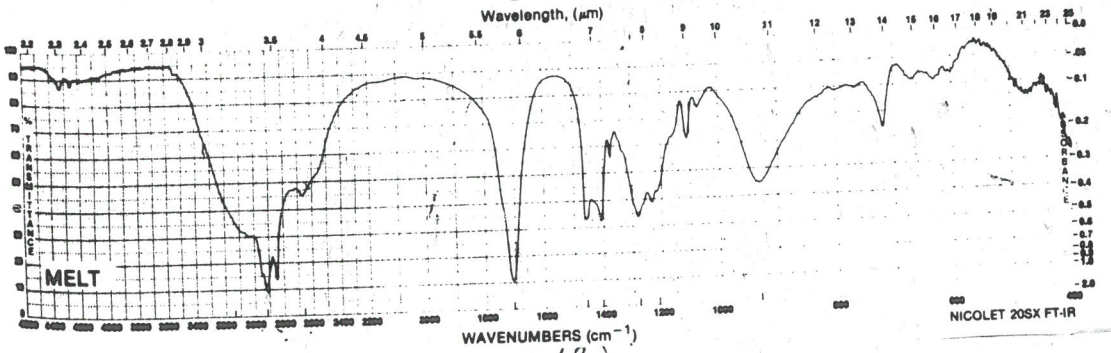
(1)

2982.1 1366.3 1031.3
1743.1 1303.6 950.8
1466.5 1243.2 606.6

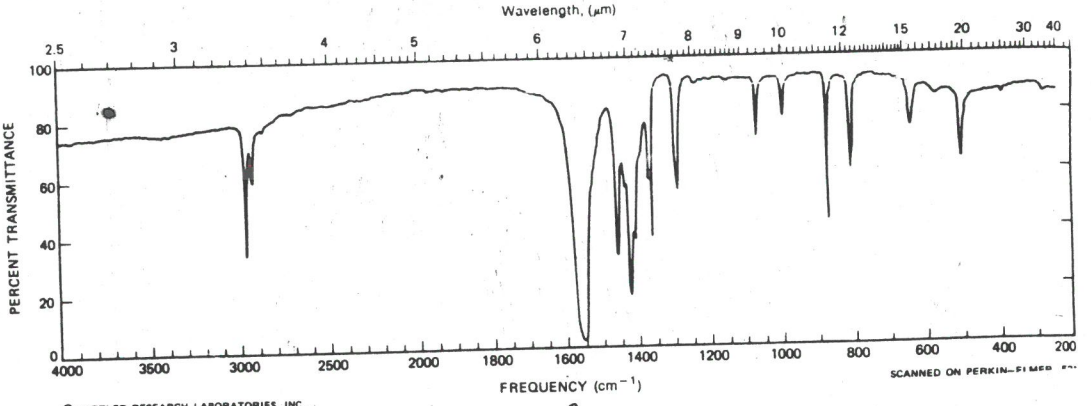



(2)

3148.2 1712.1 1285.0
2925.9 1466.3 1218.9
2870.8 1412.3 935.3

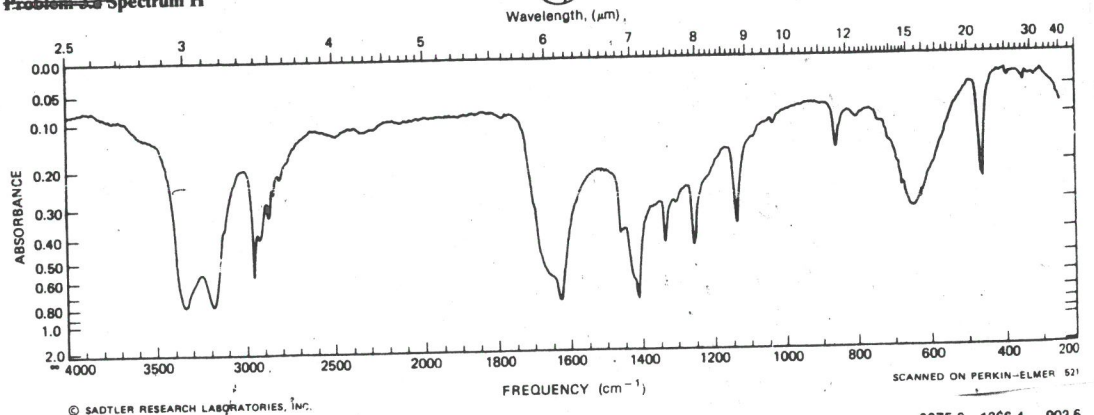



(3)



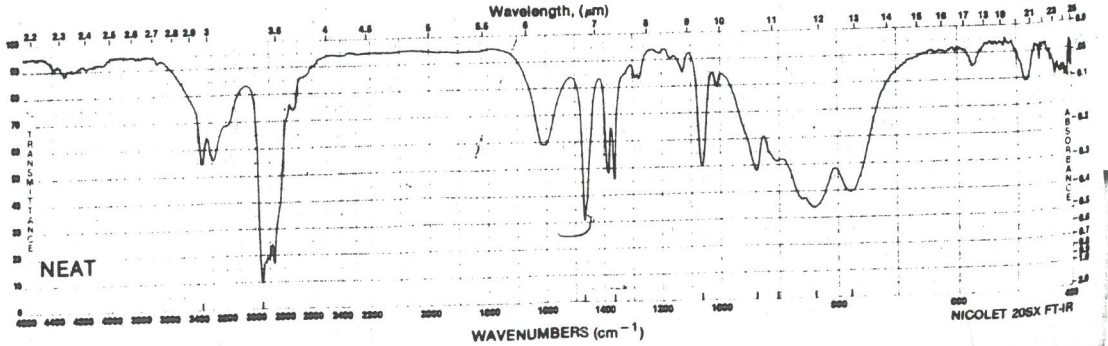

(4)

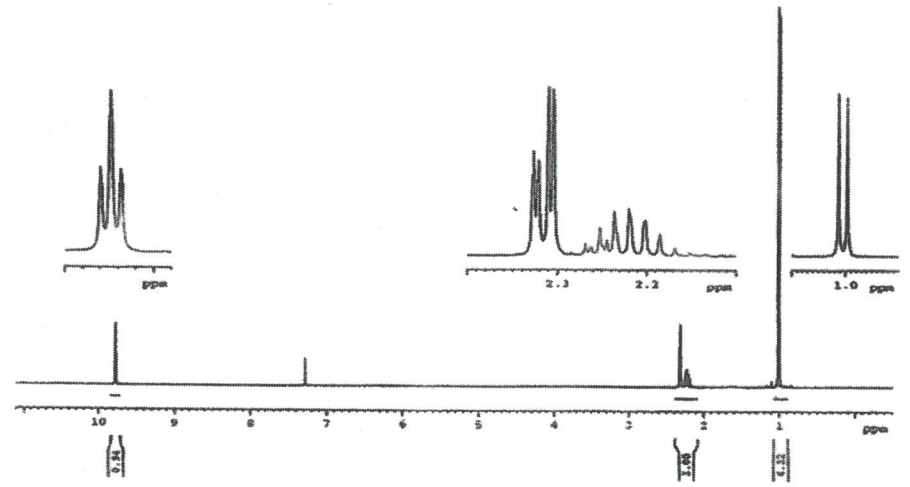
**~~Problem 3.4~~ Spectrum H**




(5)

3375.8 1366.4 903.6
2955.6 1065.7 839.0
1470.0 939.6 778.0

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2.2
ppm
1.0
ppm
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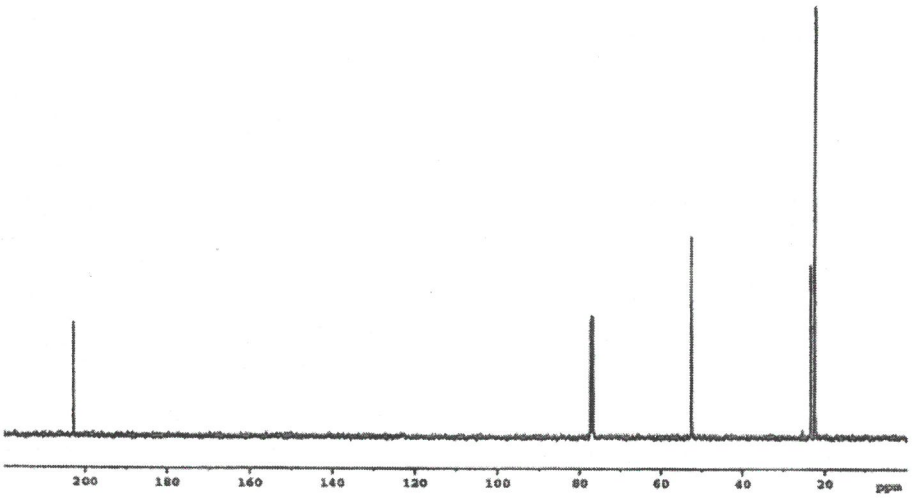
8
7
6
5
4
3
2
1
ppm
0.34
1.00
4.22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80
60
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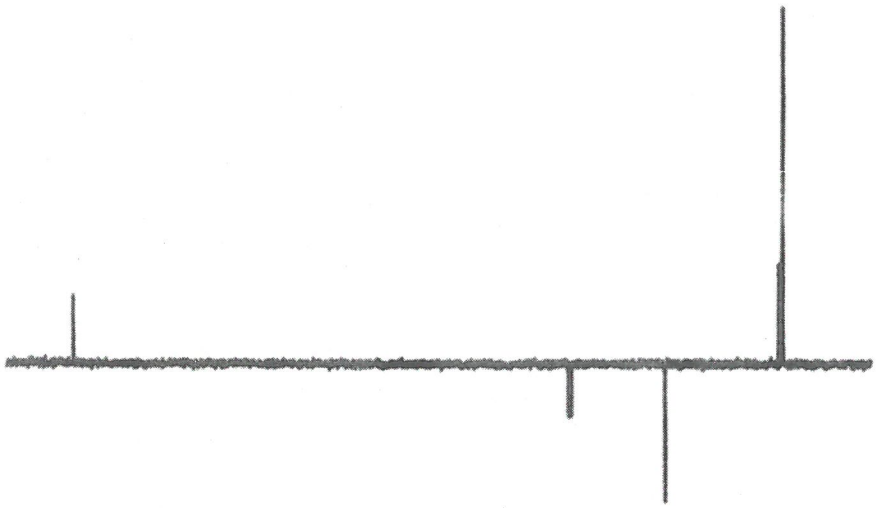
20
ppm



For Q. No. 8.