No. of Printed Pages : 5

RCH–002

Ph. D. IN CHEMISTRY

(PHDCHEM)

Term-End Examination

December, 2025

RCH–002 : ANALYTICAL TECHNIQUES IN CHEMISTRY–I

Time : 3 Hours *Maximum Marks : 100*

***Note** : There are three parts of the question paper. Answer any **six** questions from Part A; any **five** questions from Part B and any **one** question from Part C.*

Part—A

***Note** : Answer any **six** of the following in brief :* 6×5=30

1. Define spectroscopy and list different species that absorb in the UV-Vis region of the spectrum.

2. What is fingerprint region in the IR spectrum ? What is its importance ?
3. List the factors causing deviations from Beer-Lambert's law.
4. What is the importance of circular dichroism ?
5. FT-NMR is better than CW-NMR. Comment.
6. What is DEPT ? What is its importance ?
7. Draw and describe the pulse sequence for 2D-COSy spectrum.
8. What is the basic principle of mass spectrometry ?

Part—B

Note : *Answer any* ***five*** *of the following.*

5×10=50

9. Explain the origin of color in the charge transfer complexes using a suitable example.
10. Explain the phenomenon of fluorescence using Jablonski diagram.

11. What is meant by anisotropy of a chemical bond ? Explain with the help of an example.

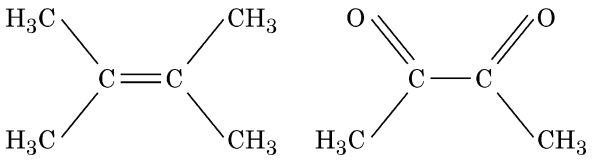
12. Explain the inversion recovery method for the determination of spin lattice relaxation time.

13. Explain the origin of m+2 peaks in the mass spectrum taking a suitable example.

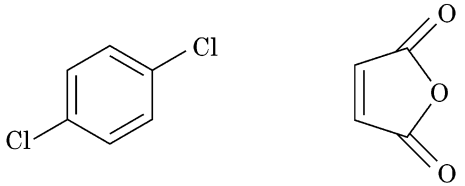
14. PF_5 has trigonal bi-pyramidal structure yet it gives only a doublet in its ^{19}F NMR spectrum. Explain.

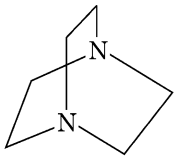
15. Which spectroscopic methods will be most suited to differentiate between the following sets of compounds ?

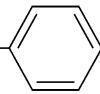
(i)

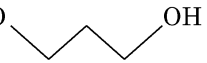
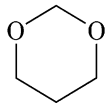


(ii)



(iii)  $N \equiv C - CH_2 - CH_2 - C \equiv N$

(iv) $Cl-CH_2$  $-O-CH_3$ Cl  $-O-C_2H_5$

(v) HO  OH 

Part—C

Note : *Answer any* ***one*** *of the following.*

1×20=20

16. The important spectral details of an organic molecule having molecular formula, $C_9H_{10}O$ are as follows :

IR : Strong absorption at 1720 cm^{-1}.

PMR : $\delta = 2.8(m, 4H)$, $\delta = 7.3(S, 5H)$ and $\delta = 9.8(t, 1H)$

CMR : signals at δ = 200, 138, 129, 128, 125, 35 and 30 ppm. Determine the structure of the organic molecule.

17. The important spectral details of an organic molecule having a molecular formula as $C_9H_{10}O_2$ are as follows :

IR : strong absorption at 1695 cm^{-1}.

PMR : $\delta = 1.3(3H, t)$, $\delta > 4.1(2H, q)$

$\delta = 7.0(2H, d)$ $\delta = 7.8(2H, d)$, $\delta = 9.8(1H, s)$.

Determine the structure of the organic molecule.

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