H-4/12/22

Roll No. .....

IV Semester Examination, 2022

M.Sc.

CHEMISTRY

Paper IV

(Spectroscopy)

Time : 3 Hours] [Max. Marks : 80

Note : *All questions are compulsory. Question Paper comprises of 3 sections. Section* ***A*** *is objective type/multiple choice questions with no internal choice. Section* ***B*** *is short answer type with internal choice. Section* ***C*** *is long answer type with internal choice.*

SECTION A **1×8=8**

(Objective Type/Multiple Choice Questions)

Note : Attempt all the *eight* questions.

Choose the correct answer :

1. Spin-spin coupling is not observed when the protons are separated by more than :

(a) One sigma bond

(b) Two sigma bond

(c) Three sigma bond

(d) Four sigma bond

P.T.O.

2. The ^{13}C, NMR spectrom of a compound shows 6 peaks and ^{1}H NMR spectrum shows 5 peaks. Which of the following is this compound ?

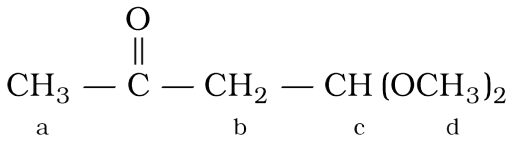
(a) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

(b) $CH_3 - C(CH_3)_2 - CH_2 - CH_2 - CH_3$

(c) $CH_3 - CH(CH_3) - CH_2 - CH_2 - C(CH_3)_2 - CH_3$

(d) $CH_3 - CH(CH_3) - CH_2 - CH_2 - CH_3$

3. Which of the hydrogens *a*—*d* in the following molecule gives a triplet signal in normal ^{1}H NMR spectrum ?



(a) hydrogen a (b) hydrogen c

(c) hydrogen b (d) hyrogen d

4. How many signals does the aldehyde $(CH_3)_3CCH_2CHO$ have in ^{1}H NMR and ^{13}C NMR spectra ?

(a) Five ^{1}H signals and six ^{13}C signals

(b) Three ^{1}H signals and four ^{13}C signals

(c) Five ^{1}H signals and four ^{13}C signals

(d) Three ^{1}H signals and six ^{13}C signals

5. Hyperfine splitting that can be observed with two equivalent protons will be :

(a) 2 (b) 3

(c) 5 (d) 6

6. The number of ESR lines for the triphenyl methyl radicals are :

(a) 156 (b) 106

(c) 150 (d) 196

7. The peak at m/z 91 in the mass spectrum for alkyl benzene is due to which one of the followings :

(a) Alpha fission

(b) Retro Diels-Alder rearrangement

(c) Mc-Laffartey rearrangement

(d) Tropylium ion formation

8. Fe* very rapidly drops to the ground state Fe, the energy change ΔE involved being 2.30×10^{-28} J per nucleus. The frequency of emitted γ-rays is :

(a) 3.1×10^{10} Hz (b) 3.5×10^{18} Hz

(c) 3.5×10^{16} Hz (d) 3.4×10^{18} Hz

SECTION B **6×4=24**

(Short Answer Type Questions)

Note : Attempt all the questions.

Unit-I

1. Discuss the contact and pseudo contact shifts with suitable examples.

Or

Discuss the karplus curve for the variation of coupling constant with the dihedral angle.

Unit-II

2. Write an explainatory notes on the following :

(a) COSY technique,

(b) DEPT technique.

Or

What is carbon-13 NMR spectroscopy ? Discuss the merits and demerits of C^{13} NMR and H^1 NMR spectroscopy.

Unit-III

3. Discuss the biological applications of ESR with examples.

Or

Explain symmetry and shapes of AB_2, AB_4 and AB_5 types of molecules.

Unit-IV

4. Describe the types of ions produced in a mass spectrometer.

Or

Discuss the formation of following Mossbaurer nucliders :

(a) ^{57}Fe (b) ^{119}Sn

(c) ^{191}Ir

SECTION C **12×4=48**

(Long Answer Type Questions)

Note : Attempt all *Four* questions.

Unit-I

1. Write down all possible structural formulae of compound having molecular formula $C_3H_6Cl_2$. Is it possible to identify them on the basis of low or/and high resolution PMR spectra ? Ignore the interaction of Cl atoms with H atom.

Or

(a) Discuss the spectrum of CH_3CH_2OH in acidic medium and in presence of D_2O.

(b) Write a note on contact shift reagents.

Unit-II

2. (a) Is spin-spin coupling between C^{13}—C^{13} nuclei observed in C-13 NMR ?

Discuss some techniques for simplification of C-13 NMR spectra.

(b) Discuss how C-13 NMR is applicable in the structure determination of carbonyl compound.

Or

Discuss the applications of photoacoustic spectroscopy in the chemical and surface analysis.

Unit-III

3. What do you understand by hyperfine splitting and hyperfine spliting constant in ESR ? Explain the hyperfine splitting in CH_3 radical.

Or

Discuss the following :

(a) Spin polarization for atoms & transition metal ions.

(b) Application of resonance spectroscopy for the study of active sites of matalloproteins.

Unit-IV

4. Discuss the basic principle of Mössbauer spectroscopy and explain this technique to the study of bonding and structure of Sn^{2+} and Sn^{4+} compounds.

Or

Discuss general fragmentation mode in organic compounds in detail with suitable examples.

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