

B.Sc. Semester - 5 (NEP-2020) Examination

Oct/Nov - 2025

CHE: Higher Chemistry-302 (Major-12)

Time: 2:00 Hours

Marks: 50

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

Que.1 Answer the following questions (any two) (10)

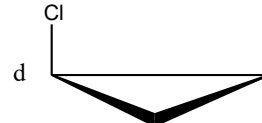
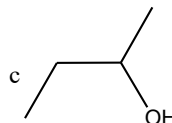
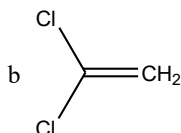
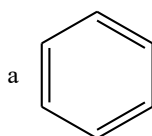
- a) Write a note on types of CO group in metal carbonyls.
- b) Discuss utility of IR spectra in the study of metal carbonyls.
- c) Explain constitution and structure of $\text{Fe}(\text{CO})_5$.

Que.2 Answer the following questions (any two) (10)

- a) Explain fundamental modes of vibrations in IR spectroscopy.
- b) Explain Overtone and Fermi resonance.
- c) Discuss types of transition responsible for UV-Visible Spectrum.

Que.3 Answer the following questions (any two) (10)

- a) Give difference between chemical shift and coupling constant J .
- b) What is magnetic anisotropy? Explain magnetic anisotropic effect in Acetylene, Ethene and 18-Annulene.
- c) Answer as directed for the following molecules.



- I. Write expected relative intensities of PMR signals due to compounds a and b in a mixture containing equimolar a and b (as a ratio a:b).
- II. Assign PMR signals as a, b, c etc. to Hydrogens of both above given molecule c and d.

Que.4 Answer the following questions (any two) (10)

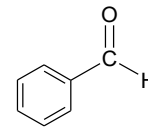
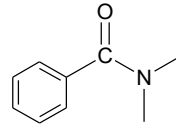
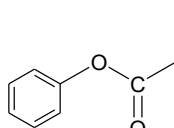
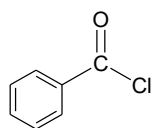
- a) For a molecule with molecular formula $\text{C}_4\text{H}_9\text{NO}$, the spectroscopic data are as below; UV: No absorption above 200. IR absorptions in cm^{-1} : 3000(s), 2980-2880(w) 1655(s), 1555(w), 1219(w) cm^{-1} . NMR: a) 3H triplet 1.2 δ b) 3H singlet 1.93 δ c) 2H quart 3.22 δ d) 1H broad singlet 8.2 δ . Determine the constitution of the molecule.
- b) Explain reversible and irreversible cell with example.
- c) Discuss secondary reference electrode:

I. Calomel.

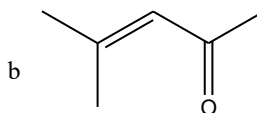
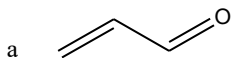
II. $\text{Ag}/\text{AgCl}/\text{Cl}^-$

Que.5 Answer the following questions (any two) (10)

- a) If the complexes obey 18 electron rule, find out x for (a) $\text{Fe}_3(\text{CO})_x$ (b) $\text{Ir}_x(\text{CO})_{12}$.
- b) Answer the following as directed.
 - I. For the molecules numbered i, ii, iii and iv, which from a,b,c and d is the correct order of carbonyl stretching frequency?

(a) $\text{ii} < \text{i} < \text{iii} < \text{iv}$ (b) $\text{i} < \text{iii} < \text{ii} < \text{iv}$ (c) $\text{iv} < \text{ii} < \text{iii} < \text{i}$ (d) $\text{iii} < \text{iv} < \text{ii} < \text{i}$

II. Calculate UV absorption $\lambda_{\max}$ values for the following a and b.



- c) A compound with molecular weight 122 gm/mole gives three singlets at the given chemical shift values with area under the curve as given here. a) 3.55 δ , 15sq., b) 4.88 δ 10sq., c) 7.8 δ 25sq. If the elemental analysis shows C=78.68 % and H=8.20 %, Deduce its constitution.
- d) For a molecule with molecular formula $C_9H_{11}O_2N$, the UV, IR and PMR spectral properties are $\lambda_{\max} = 315\text{nm}$
 IR: 3550 cm^{-1} , 3105-3035(s) cm^{-1} , 2990(s) cm^{-1} , 1720 cm^{-1} , 1590-1490 cm^{-1} , 1220-113-1590-1490 cm^{-1} , 830 cm^{-1}
 NMR: a) 6H singlet 2.85 δ b) 2H doublet 6.80
 c) 2H doublet 7.95 δ d) 1H singlet 11.0 δ

SPECTRAL DATA

Diene $\lambda_{\max}$ (Base)	Enone $\lambda_{\max}$	Arone $\lambda_{\max}$	IR cm^{-1}	Type of Vibrations	Type of H	PMR- δ
Simple=217	Z=C=215	Z=C=246	3550	O-H str	$\text{sp}^3 \text{ C-H}$	0.9 – 2.0
Homoannu=253	Z=C=205	Z=H=250	3105-3035(s)	ArC-H str	C=C-CH ₃	1.6 – 2.3
Heteroann=215	Z=H=210	Z=OH=230	3000(s)-2990(s)	C-H str methyl	Ar-CH ₃ , Ar-NCH ₃	2.2 – 3.0
		Z=OR=230			C $\equiv$ C-H, CO-CH ₃	~2.5
			2980-2880(w)	R-C-H str	RO-CH ₃	3.3 – 4.0
			1720	C=O str	R-CH ₂ -X Ar-CH ₂ -O	3.0 – 4.5 4.4-4.9
			1655(s)	R-C=O str	-OH	1.0 – 5.0
			1590-1490	C=C (Ar)	-NH ₂ , -NHR	1.0 – 3.3,
			1555(w)	R-C-N	C=C-H	4.5 – 6.5
			1219(w)	Ar-C-N str	Ar-H	6.0 – 8.5
			830	Para-Disub	-CHO, N-H	8.2 -10.5
					-COOH	10.0-13.0
