2026

M.Sc. 2nd Semester Examination

CHEMISTRY

MIDNAPORE CITY COLLEGE ESTD 2017 CENTRAL LIBRARY

Paper : CEMC452X0

(Inorganic Chemistry-II)

Full Marks : 50 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group - A

Answer any ***four*** questions : 2×4=8

1. Determine the characters of irreducible representations for C_{4v} point group. Write the appropriate Mulliken symbols for these irreducible representations. 1+1

2. Energy of α-spin of electron increases linearly, whereas that of β-spin of electron decreases with the increase in external magnetic field strength. — Explain.

3. Calculate the '*g*' value of an unknown radical which shows an ESR line at 1.301 T in a spectrometer operating at 39.41 GHz. (Given $\beta = 9.27 \times 10^{-24} JT^{-1}$).

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4. What happens when :

   (i) $CpFe(CO)_2I$ is reacted with C_2H_4 in presence of $AgBF_4$.

   (ii) $ZrCl_4$ is reacted with C_3H_5MgCl in Et_2O at low temperature. 1+1

5. What is a dipole-dipole interaction in supramolecular chemistry? Show the dipole-dipole interactions present in acetone. 1+1

6. Write down the structural features of boron hydride compounds.

Group - B

Answer any ***four*** questions : 4×4=16

7. Verify that the wave functions of p_x and p_y orbitals, as a pair, provided the basis for a irreducible representation in C_{3v} environment.

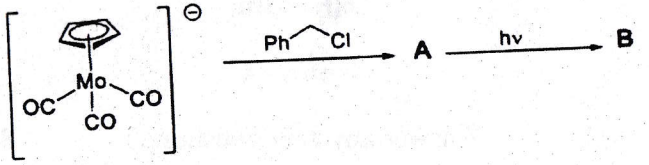
C_{3v}	E	$2C_3$	$3\sigma_v$		
A_1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	−1	R_z	
E	2	−1	0	$(x, y)(R_x, R_y)$	$(x^2-y^2, xy)(xz, yz)$

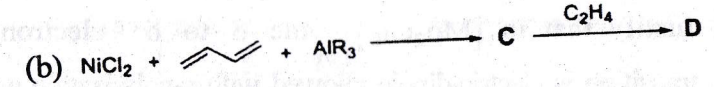
8. Considering weak zero-field splitting, predict the ESR spectrum of Mn(II) octahedral high spin complex. (I_{Mn}= 5/2).

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9. Show that the representation of a direct product, Γ_{MN}, will contain the totally symmetric representation only if the irreducible Γ_M = irreducible Γ_N. (Where $\Gamma_{MN} = \Gamma_M \times \Gamma_N$ and the symbols have their usual meanings)

10. Complete the following reactions and mention the oxidation states of metal centres present on the products [A to D] :

(a) 

(b) 

11. Explain the appearance of three lines of 1:2:1 intensity ratio in the EPR spectrum of a radical where hyperfine coupling occur with two equivalent hydrogen atoms.

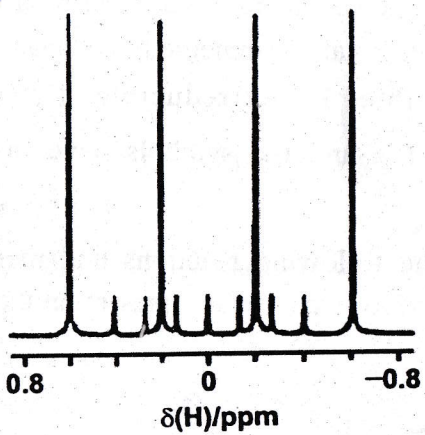
12. Explain the following ^1H NMR spectrum of KBH_4 (recorded in D_2O).

$(I_{11_B} = 3/2, I_{10_B} = 3)$

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Group - C

Answer any *two* questions : 8×2=16

13. Justify that in $[Mo_2Cl_8]^{4-}$ the δ to δ* electronic transition is electric-dipole allowed with *z*-polarization and forbidden for radiation with its electric vector in the *xy* plane.

D_{4h}	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$		
A_{1g}	1	1	1	1	1	1	1	1	1	1		x^2+y^2, z^2
A_{2g}	1	1	1	−1	−1	1	1	1	−1	−1	R_z	
B_{1g}	1	−1	1	1	−1	1	−1	1	1	−1		x^2-y^2
B_{2g}	1	−1	1	−1	1	1	−1	1	−1	1		xy
E_g	2	0	−2	0	0	2	0	−2	0	0	(R_x, R_y)	(xz, yz)
A_{1u}	1	1	1	1	1	−1	−1	−1	−1	−1		
A_{2u}	1	1	1	−1	−1	−1	−1	−1	1	1	z	
B_{1u}	1	−1	1	1	−1	−1	1	−1	−1	1		
B_{2u}	1	−1	1	−1	1	−1	1	−1	1	−1		
E_u	2	0	−2	0	0	−2	0	2	0	0	(x, y)	

14. (i) How will you synthesise $(OC)_5W{=}\overset{R}{\underset{OMe}{\langle}}$ from $W(CO)_6$?

(ii) Write the conditions of a metal centre and carbene ligands to form weak and strong metal-carbene bonds in Fischer's carbene complex.

(iii) Show the hydrogen-bonded interactions in the 'Eigen cation' and the 'Proton sponge'.

(iv) Complete the following reactions :

(a) $\left[(OC)_5Cr{-}C(=O)R\right]^{\ominus} \xrightarrow[-78^0C]{\text{ClC(=O)C(=O)Cl}}$

(b) $Cp_2Ti(CO)_2 + Ph{-}{\equiv}{-}Ph \xrightarrow[25°C,\ 3h]{\text{heptane}}$

2+2+2+2

15. (a) Calculate *styx* numbers of $[B_8H_{10}]^{2-}$ and $[B_9H_{13}]$. Establish the most probable structures of these two boron hydrides.

(b) *styx* numbers for two boron hydrides are 1820 and 2640. Using these data determine the most probable structures of these two boron hydrides.

4+4

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16. (a) What is meant by metallophilicity? Write the types of metallophilic interactions present in supramolecular systems?

(b) Classify the following compounds as closo/nido/ arachno/hypo types with justification :

$Cp_2Co_2(C_2B_{10}H_{12}), (Ph_2PCH_2)_2 Ni(Me_4C_4B_8H_8)$

(c) What is ion-ion interaction in supramolecular chemistry? Give an example. Mention the factors upon which the strength of ion-ion interactions depends.

(d) Predict the ESR spectrum of di-t-butyl nitroxide radical. 2+1+2+3

[Internal Assessment : 10 marks]

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