

M.Sc. 2nd Semester Examination, 2025

CHEMISTRY

(Inorganic)

PAPER – CEM-203

Full Marks : 50

Time : 2 hours

Answer all questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

Answer any four questions : 2 × 4

1. What happens when :

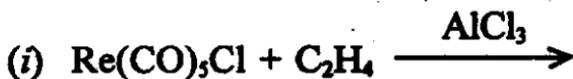
- (i) $\text{Mo}(\text{CO})_6$ is refluxed with norborane diene in octane ?

(Turn Over)

(2)

(ii) $\text{Cr}(\text{CO})_6$ is reacted with $\text{Li}[\text{N}(\text{i-pr})_2]$ in presence of Et_3O^+ ?

2. Complete the following reactions :



3. The energy integral $\int \psi_i H \psi_j d\tau$ may be non-zero only if ψ_i and ψ_j belong to the same irreducible representation of the molecular point group. Explain.

4. Is p_x to p_y an allowed transition in a tetrahedral environment ? Explain.

T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$	
A_1	1	1	1	1	1	$(x^2 + y^2 + z^2)$
A_2	1	1	1	-1	-1	
E	2	-1	2	0	0	$(2z^2 - x^2 - y^2, x^2 - y^2)$
T_1	3	0	-1	1	-1	(R_x, R_y, R_z)
T_2	3	0	-1	-1	1	(x, y, z) (xy, xz, yz)

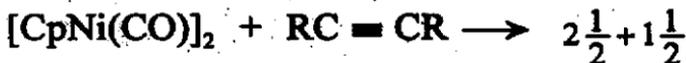
5. What is boron neutron capture therapy? Give at least two examples of 1st and 2nd generation BNCT agents.
6. Write down all the product obtained from the polymerization chain reaction of BH_3 in a sealed glass tube.

GROUP - B

Answer any four questions : 4 × 4

7. (i) 'Highly explosive halogen substituted acetylenes can be stabilized by complex formation' - justify the statement with a suitable example.

(ii) Complete the following reaction :



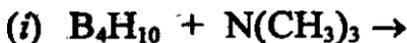
8. (i) How $(\text{OC})_5 \text{W} \equiv \text{C} - \text{R}$ is synthesized from its corresponding carbene complex ?

(ii) Discuss the orbital interactions present in Scroock's carbyne complex. $1\frac{1}{2} + 2\frac{1}{2}$

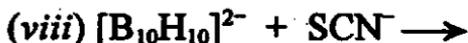
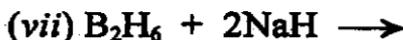
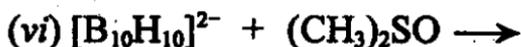
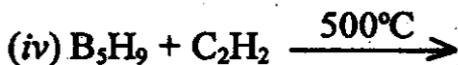
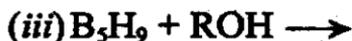
9. Determine the characters of irreducible representations for C_{4v} point group. Write the appropriate Mulliken symbols for these irreducible representations. $3 + 1$

10. Based on group theoretical principle discuss on "spectral transition probabilities" of an electric dipole transition. 4

11. Complete the following reactions : $\frac{1}{2} \times 8$



(5)



12. Classify the following compounds with respect to closo, nido, arachno and hypo

4



GROUP - C

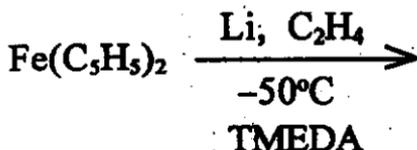
Answer any two questions :

8 × 2

13. (i) 'Highly strained cycloolefins are stronger

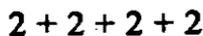
donors than non-cyclic olefins'-Justify the statement with an example.

- (ii) Complete the following reaction and mention the oxidation state of the central metal ion.



- (iii) What happens when Mo(g) and 1,3-butadiene(g) is reacted at very low temperature.

- (iv) Draw the orbital diagram to show the bonding model in Schrock carbene complex.



14. (i) Verify that p_x and p_y orbitals provide basis for B_1 and B_2 representation, respectively, of C_{2v} point group, whereas p_x and p_y orbitals as a pair provide basis for E representation of C_{3v} point Group.

(ii) Using group theoretical principle to justify that $n \rightarrow \pi^*$ electronic transition is forbidden, whereas $\pi \rightarrow \pi^*$ electronic transition is allowed in formaldehyde molecule.

(1 + 3) + 4

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma'_v(yz)$		
A_1	1	1	1	1	Z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

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	$(x, y)(R_x, R_y)$	$(x^2 - y^2, xy)(xz, yz)$

15. (i) Calculate the styx number of $[B_6H_{12}]^{2-}$, $[B_8H_{14}]$ and established the most probable structure.

- (ii) With the help of styx number 3411 and 2221 derive the formula of the boron hydride and draw the probable structures of these.

4 + 4

16. (i) Show that the representation of a direct product Γ_{XY} , will contain the totally symmetric representation only if the irreducible $\Gamma_X =$ the irreducible Γ_Y .

- (ii) Classify the following compounds with respect to closo, nido, arachno and hypo
 $\text{Cp}_3\text{Co}_3\text{B}_4\text{H}_4$, $\text{Cp}_2\text{Fe}_2\text{Me}_4\text{C}_4\text{B}_8\text{H}_8$,
 $(\text{CH}_3)_3\text{C}_2\text{B}_5\text{H}_{11}$, $\text{Et}_4\text{C}_4\text{B}_8\text{H}_8$

4 + 4

[Internal Assessment – 10 Marks]
