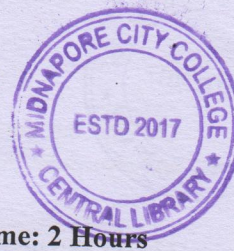PG (NEW) CBCS
M.Sc. Semester-II Examination, 2019
CHEMISTRY
PAPER: CEM-203
(INORGANIC CHEMISTRY - II)

Full Marks: 40

Time: 2 Hours

Group-A

Answer any four questions of the following: 2×2=4

1. Write down the four important principles to construct the character table for a point group of symmetry.
2. NMR-spectroscopy is a useful technique to monitor fluxional behavior- Justify.
3. Explain why no polarization is observed in cubic or higher symmetry molecules.
4. What do you mean by 'Agostic interaction'?
5. Draw the orbital overlap in Schrock's carbine complex.
6. What do you mean by Berry pseudo rotation?
7. Show the different bonding modes of dinitrogen in dinuclear transition metal-dinitrogen complexs.
8. Why square planer complexes sometimes violet 18-electron rule- Explain with an example.

Group-B

Answer any four questions of the following: 4×4=16

9. (a) How transition metal orbitals interact with the molecular orbitals of an allyl ligand?

(b) The structure of cyclobutadiene itself is rectangular, while it is close to square in the coordination compound – comment.   (3+1)

10. (a) What is Creutz-Taube complex?

(b) Why the chemistry of these complexes was studied?   (2+2)

11. Write down the synthesis of tungsten bronze and explain its semi-conductivity property.   (4)
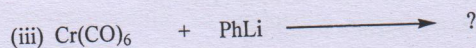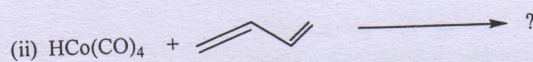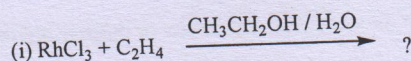
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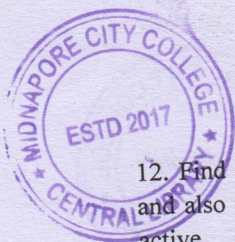
(2)

12. Find out the normal fundamental modes of vibration of CH_2Cl_2 molecule and also point out which mode is/are IR active and which mode is/are Raman active. (4)

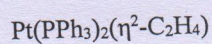13. (a) Discuss the phenomenon of 'Carbonyl scrambling' in $[FeCp(CO)_2]_2$ complex.

(b) Calculate the styx number of $[B_6H_6]^{-2}$. (2+2)

14. What is boron neutron capture therapy? Give at least two example of 1st and 2nd generation BNCT AGENTS. (4)
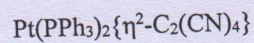
15. Complete the following reactions:

(i) $RhCl_3 + C_2H_4 \xrightarrow{CH_3CH_2OH / H_2O}$?

(ii) $HCo(CO)_4$ + ⟶ ?

(iii) $Cr(CO)_6$ + PhLi ⟶ ?

(iv) $[Ir(CO)Cl(PPh_3)_2]$ + C_{60} ⟶ ? (4 x 1)

16. (a) The Pt- C and C-C bond length data are given for complex (1) and (2).

$Pt(PPh_3)_2(\eta^2-C_2H_4)$	$Pt(PPh_3)_2\{\eta^2-C_2(CN)_4\}$
(1)	(2)
d_{C-C} : 1.43 Å	d_{C-C} : 1.49 Å
d_{Pt-C} : 2.11 Å	d_{Pt-C} : 2.11 Å

Draw the structure of complex (1) and (2) and discuss their bonding. (4)

(b) Classiy the following compounds with respect to closo, nido, arachino and hypo.

$B_3H_6^+$, $B_4H_6(CoCp)_2$, $B_3H_7[Fe(CO)_3]_2$, $B_2H_7^-$ (2+2)
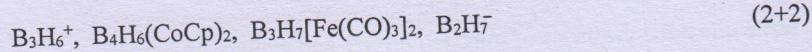
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Group-C

Answer any two questions of the following: $2\times8=16$

17. (a) Establish the relation: (2+4+2)

$$a_i = \frac{1}{h}\sum_R x(R)x_i(R)$$

Where the terms have their usual significance.

(b) The ground state of trans $- N_2F_2$ is B_g . To what excited states may it be excited by electric dipole transitions and what polarization of light is necessary to use?

**Character table for C_{2h} point group**

	E	C_2 (z)	i	σ_h	linear, rotations	quadratic
A_g	1	1	1	1	R_z	x^2, y^2, z^2, xy
B_g	1	-1	1	-1	R_x, R_y	xz, yz
A_u	1	1	-1	-1	z	
B_u	1	-1	-1	1	x, y	

(c) Show that the representation of a direct product, Γ_{AB} will contain the totally symmetric representation only if the irreducible Γ_A = the irreducible Γ_B.
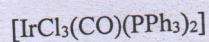
18. (a) Which of the following metal alkene complexes do you think will look most like a metallacyclo propane? Explain your answer:

(i) $(CH_2=CH_2)Ni(PPh_3)$

(ii) $(CH_2=CH_2)Fe(CO)_4$
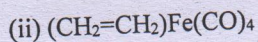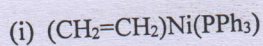
(b) The change of CO stretching frequency in the IR spectrum of compound (1) and (2) given below:

$[IrCl(CO)(PPh_3)_2]$ $\bar{\upsilon}_{CO}$: 1967 cm^{-1}
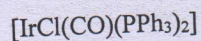
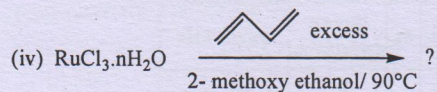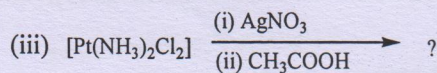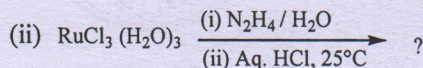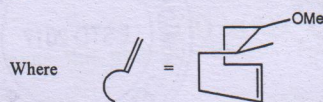$[IrCl_3(CO)(PPh_3)_2]$ $\bar{\upsilon}_{CO}$: 2075 cm^{-1}

Why does the position of $\bar{\upsilon}_{CO}$ in the IR spectrum shift?

(4)

(c) Complete the following reaction:

(i) + KO_2 ⟶ ?

Where =

(ii) $RuCl_3 (H_2O)_3$ $\xrightarrow[\text{(ii) Aq. HCl, 25°C}]{\text{(i) } N_2H_4 / H_2O}$?

(iii) $[Pt(NH_3)_2Cl_2]$ $\xrightarrow[\text{(ii) } CH_3COOH]{\text{(i) } AgNO_3}$?

(iv) $RuCl_3.nH_2O$ $\xrightarrow[\text{2- methoxy ethanol/ 90°C}]{\text{excess}}$?

(2+2+4)

19. (a) Using 3N Cartesian coordinates find out the character for all symmetry operators corresponding to reducible representation of H_2O molecule. (Assuming xz as the molecular plane)

(b) Find out the number of irreducible representation present within the above reducible representation.

(c) Show that the angular wave function $(3Cos^2\theta - 1)$ signifies the d_{z^2} orbital.

(3+3+2)

(20) Show that $n \longrightarrow \pi^*$ electric dipole transition is forbidden but $n \rightarrow \pi^*$ transition is allowed for HCHO molecule.

Character table for C_{2v} point group given below: 8

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

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