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PG CBCS

M.SC. Semester-II Examination, 2021

CHEMISTRY

PAPER: CEM 203

(**INORGANIC CHEMISTRY - II**)

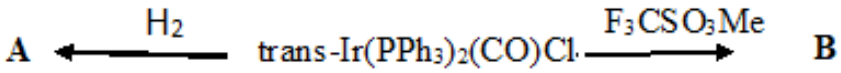
Full Marks: 40 **Time: 2 Hours**

Answer any FOUR questions: **10X4=40**

1. (a) Using the 18 electron rule to draw the structure for each of the following compounds:

   (i) $[(\square^5\text{-}C_5H_5)Mo(CO)_2]_2$, (ii) $Ir_4(CO)_{12}$, (iii) $Os_4(CO)_{16}$, (iv)$[Ru_3(CO)_{10}(PPh_3)_2]$

   (b) The following reactions have been known to proceed via different mechanisms. Predict products **A** and **B**, including stereochemistry, and the mechanism for each reaction.(5+5)

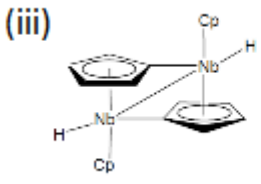


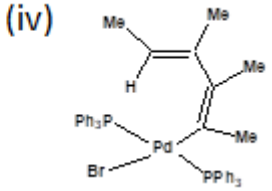
2. (a) The *cis*-isomer of $L_2Pd(Et)_2$ decomposes immediately to give butane, but the *trans* isomer produces a 1:1 mixture of ethene and ethane. - Explain.

   (b) On forming $[Ir(Br)(CO)\{\eta^2\text{-}C_2(CN)_4\}(PPh_3)_2]$ the unique C-C bond in $C_2(CN)_4$ lengthens from 135 to 151 pm. Explain. 5+5

3. (a) Which of the following compounds have 18 electrons? Predict the oxidation state for each compound:

   (i) $[(\square^7\text{-}C_7H_7)Mo(CO)_3]^+$, (ii) $[(\square^5\text{-}C_9H_7)Re(CO)_3]$,





(b) Explain which compound will have the higher CO stretching frequency in each of the following pairs:

(i) $[Mo(CO)_4(PMe_3)_2]$ and $[W(CO)_4\{P(OMe_3\}_2]$;

(ii) $[Mn(CO)_6]^+$ and $[V(CO)_6]^-$;

(iii) $Fe(CO)_5$ and $[Fe(CO)_6]^{2+}$ 4+6

4. (a) Give an examples of metal alkyls which are stable to □-hydride elimination.

(b) When CO becomes coordinated to BH_3 its stretching frequency increases, but when CO becomes coordinated to $Ni(CO)_3$ its stretching frequency decreases. -Explain. 5+5

5. (a) Write down the four important principles to construct the character table for a point group of symmetry.

(b) Show the different bonding modes of dinitrogen in dinuclear transition metal-dinitrogencomplexs.

(c) (b) What is Creutz-Taube complex? Why the chemistry of these complexes was studied? 4+3+3

6. (a) What is boron neutron capture therapy? Give at least two example of 1st and 2nd generation BNCT AGENTS.

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

(c) What is meant by 'Agostic interaction'? 5+3+2

7. (a) Show that n→ π*electronic transition is forbidden but π→ π*transition is allowed for HCHO molecule. Character table for C_{2v} point group is given below: 4+2+4

	E	C_2 (z)	σ_v(xz)	σ_v(yz)	linear, rotations	quadratic
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

(b) State the selection rules for IR and Raman transition.

(c) What do you mean by "Exclusion principle"? Justify this principle using *trans*-N_2F_2 as an example. Character table for C_{2h} point group is given below:

C_{2h}	E	C_2	i	σ_h		
A_g	1	1	1	1	R_x,	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	

8. (a) What is projection operators? 2+4+4

(b) Find the IR and Raman active modes of H_2O molecule.

(c) The following table is given for C_{3v} point group:

C_{3v}			
Γ_1	1	1	1
Γ_2	1	L	M
Γ_3	2	P	Q

Find the Value for L, M, P &Q. Write down the Mulliken term symbol for Γ_1, Γ_2, Γ_3.

OR

Draw the M.O. diagram for H_2O molecule using projection operator technique. 10

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