2024

M.Sc.

3rd Semester Examination

CHEMISTRY

PAPER – CEM-302

Full Marks:50

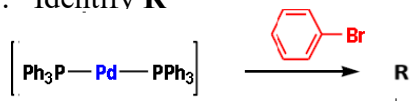
Time : 2 Hours

(CEM 302-Advanced Inorganic Chemistry-I)

Group-A

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

1. Identifv **R**



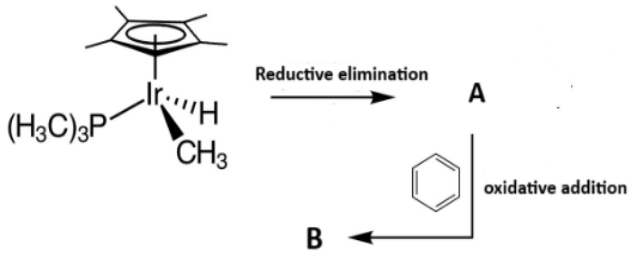
2. For the d^2 electronic system calculate the ground state term symbol and draw the Orgel diagram
3. Give an example for double-decker compound and 1,1 migratory insertion reaction.
4. What is orthometallation reaction?
5. Discuss agostic interaction with suitable example.
6. How does the Jahn-Teller distortion affect the energy levels of the orbitals?

Group-B

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

7. How does the alteration of transition dipole moments affect the intensity of electronic transitions? What is the effect of lowering symmetry on the transition dipole moments of a molecule?(2+2)
8. What is Wilkinson's catalyst? For what type of reaction Wilkinson's catalyst is commonly used? Describe the mechanism of hydrogenation of alkenes using Wilkinson's catalyst. (2+2)
9. i) Give one example of the insertion of CO into a Metal-Alkyl Bond.

ii) Identify A and B

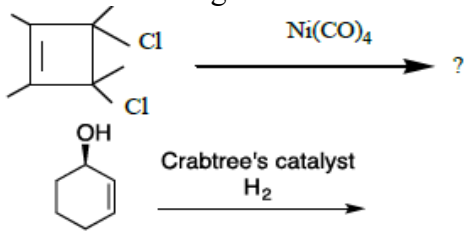


(2+2)

10. What are the reactants and products in the Monsanto acetic acid preparation process? Write the catalytic cycle for the Monsanto acetic acid. (1+3)

11. Describe the differences between sp^3, sp^2, and sp hybrid orbitals in terms of their symmetry. 4

12. What is the driving force for carbonyl insertion? Predict the products of the followings: (2+2)



Group-C

Answer any ***two*** questions $2\times8 = 16$

13. i) How does the Tanabe-Sugano diagram relate the energy of the d-orbitals to the ligand field strength? ii) Draw the Tanabe-Sugano diagram for d^2 orbital. (3 + 5)

14. i) What are the most common catalysts used in the hydroformylation reactions? ii) Discuss the mechanism of the hydroformylation reaction. (iii) Draw the MO diagram of $[Cr(H_2O)_6]^{3+}$. (2+4+2)

15. i) Determine the symmetry and combinations of LGOs and metal orbitals in a square planar complex. ii) Decarbonylation of cis-$[(CH_3CO)Mn(*CO)(CO)_4]$ through the CO-insertion Pathway and CH_3-migration pathway give the different stereochemical results. -justify. iii) Synthesize $[Cp_3Ni_2]^+$ from nickelocene. (4+2+2)

16. With the help of group theory determine the symmetries of the group of orbitals of F atoms which are effective for σ-bond formation in PF_5 molecule. Write the appropriate SALCs for these symmetries. Construct a qualitative σ-bonding M.O energy level diagram for PF_5. (Given below the character table for D_{3h} point group). (6+2)

Character table for D_{3h} point group

D_{3h}	E	$2C_3$	$3C'_2$	σ_h	$2S_3$	$3\sigma_v$	linear, rotations	quadratic
A'_1	1	1	1	1	1	1		x^2+y^2, z^2
A'_2	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x, y)	(x^2-y^2, xy)
A''_1	1	1	1	-1	-1	-1		
A''_2	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)

.....

Internal Assessment-10