Total Pages: 3

PG CBCS

M.Sc. Semester-III Examination, 2020

CHEMISTRY

PAPER: CEM 302

(INORGANIC SPECIAL)

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

Answer any four questions from the following: 4x10 =40

1. (a) What do you mean by insertion reaction and oxidative coupling?

(b) Why do the configuration d^n and d^{10-n} give identical ligands field term in any given field symmetry?

(c) What is the hole formalism?

(d) Write some advantages of rhodium catalyst over cobalt catalyst for hydroformylation reaction. 2.5 × 4

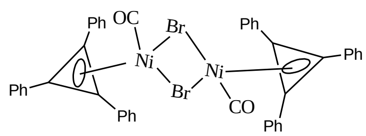
2. (a) What do you mean by 'Exclusion rule'?

(b) What is "Sandwich compound"? Give an example.

(c) What is the role of hydroiodic acid in Monsento process of acetic acid synthesis?

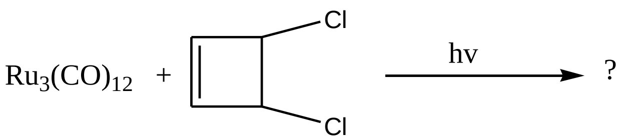
(d)Show that the f-orbital whose angular wave functions is constant times $Sin^2\theta Cos\theta Sin2\Phi$ is f_{xyz} orbital. 2.5 × 4

3. (a) How will you synthesize



via dehalogenation of cyclopropene starting from $Ni(CO)_4$.

(b) Complete the following reaction:



(c) The addition of PPh3to RhCl(PPh3)3reduces the hydrogenation TOF(Turn over frequency).-Justify. 4+3+3

P.T.O.

4. (a) Briefly discuss the catalytic cycle for 'Monsento acetic acid' process using $[Rh(CO)_2I_2]^-$ catalyst. Mention oxidation states of 'Ru' in each step.

(b) Write down the catalytic cycle for the hydroformylation reaction using $HCo(CO)_4$ as catalyst.

(c) Establish the relation: $\chi(\alpha) = \frac{Sin(l+\frac{1}{2})\alpha}{Sin(\frac{\alpha}{2})}$

Where the terms have usual significance. 4+3+3

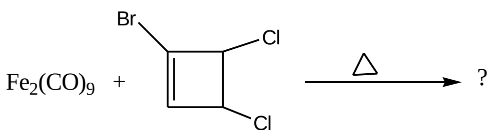
5. (a) Show that the d-orbital whose angular wave function is constant times $(Sin^2\theta Cos2\theta)$ is $d_{x^2-y^2}$ orbital. 2

(b) State the spectral selection rules of the electronic dipole transition of the vibrationl modes of IR and Raman active molecules. 2

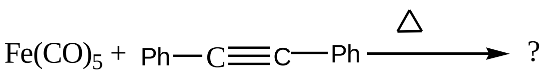
(c) Find out the ground and excited state terms for d^2 free ion. Use Hund's rule to identify the ground state. 4

(d) Predict the product of the following reaction: 1+1

(i)



(ii)



6. Find out IR and Raman active vibrational modes of NH_3 molecule. Character table for C_{3v} point group is given below. 10

C_{3v}	E	$2C_3$	$3\sigma_v$	Basis components		
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)	$(x^2-y^2,xy)(yz,xz)$

7. Write down the complete reaction for the production of CH_3CHO from C_2H_4 by Wacker's process. Write down the rate equation for the process. Draw the catalytic cycle for the process. 3+3+4

8. What is Ziegler-Natta catalyst? Mechanistically explain the stereo regularity of polymerization of olefin with this catalyst. 3+7

9. What is projection operator? Find the SALCs of cyclopropenyl cation using projection operator technique and draw the energy level diagram. 1+6+1

Character table for D_{3h} point group is given below.

D_{3h}	E	$2C_3$	$3C_2'$	σ_h	$2S_3$	$3\sigma_v$		
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)

10. Draw the correlation diagram of d^2 configuration in octahedral complexes. Character table for O_h point group is given below. 10

O_h	E	$8C_3$	$6C_2$	$6C_4$	$3C_2$	i	$6S_4$	$8S_6$	$3\sigma_h$	$6\sigma_d$		
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		
E_g	2	-1	0	0	2	2	0	1	2	0		$2z^2-x^2-y^2, x^2-y^2$
T_{1g}	3	0	-1	1	-1	3	1	0	-1	-1	R_x, R_y, R_z	
T_{2g}	3	0	1	-1	-1	3	-1	0	-1	1		xz, yz, xy
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1		
A_{2u}	1	1	-1	-1	1	-1	1	-1	-1	1		
E_u	2	-1	0	0	2	-2	0	1	-2	0		
T_{1u}	3	0	-1	1	-1	-3	-1	0	1	1	x, y, z	
T_{2u}	3	0	1	-1	-1	-3	1	0	1	-1		

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