

DEPARTMENT OF CHEMISTRY
SCHOOL OF CHEMICAL AND LIFESCIENCES, JAMIA HAMDARD
MSc. CHEMISTRY, SEMESTER-II EXAMINATIONS-2022
PAPER CODE: MCHCC-203
PAPER TITLE: INORGANIC CHEMISTRY-II

(Write your Roll No. at the top immediately on receipt of this question paper)

Time: 3 hours

Maximum Marks: 75

Attempt all questions. All parts of a question must be attempted in continuation. Start answer of a fresh question on a new page. Cite examples and draw labelled diagrams whenever necessary.

Q1. Attempt all questions:

(1x15=15)

- a. What is Wacker's process.
- b. Give the reaction of Wilkinson catalyst.
- c. Explain isolobal fragments.
- d. State the Sidgwick 18 electron rule.
- e. Draw the structures of SiO_4^{4-} and $\text{Si}_2\text{O}_7^{6-}$.
- f. Give preparation, properties and structure of S_4N_4 .
- g. What is inorganic benzene? How does it differ from benzene?
- h. Give the point group of any two of the following molecules: B_2H_6 , P_4 and CO_2 .
- i. Give meanings of any three of the following: A_2 , B_1 , E'_{2g} , T_{1u}'' .
- j. Define the terms symmetry element and symmetry operation.
- k. What is meant by order of axis?
- l. Write down the basic principle of EPR.
- m. Differentiate between the contact and pseudo contact shifts.
- n. What is meant by 'g' value?
- o. Draw the structure of AB_3 and AB_5 types of molecules with examples.

Q2. Attempt any three of the following:

(3x5=15)

- A. Determine the bond order for the metal-metal bond in the following clusters:
a) $\text{Fe}_3(\text{CO})_{12}$ b) $\text{Ir}_4(\text{CO})_{12}$
- B. Discuss the structure and bonding in metal carbonyls. How does a vibrational spectrum support the bonding scheme in metal carbonyls?
- C. Discuss the methods of preparation, properties and bonding in ferrocene complexes.
- D. Explain the following giving examples: i) oxidative addition ii) reductive elimination.
- E. Give in details the Zeigler-Natta polymerization of olefins.

Q3. Attempt any three of the following:

(3x5=15)

- A. Write short notes on (a) Chevrel phases (b) Zintl ions
- B. Discuss the structure of Re_2Cl_8 and justify for its bond order using molecular orbital theory.

- C. Give the structure of the following clusters: a) $\text{Mo}_6\text{Cl}_{12}$ b) PbMo_6S_8 .
 D. Explain the structure of cage and clusters giving suitable examples.
 E. Discuss the synthesis, structure and bonding of phosphazenes.

Q4. Attempt any three of the following:

(3x5=15)

- A. Determine the irreducible representation of each of the fundamental vibrations of H_2O . Which are IR and Raman active vibrations?

Character table for C_{2v} point group

	E	$C_2(z)$	$\sigma_v(xz)$	$\sigma_v(yz)$	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. What is Born Haber cycle? Explain Born Haber cycle for the formation of NaCl.
 C. List all the operations of point groups of square planar & trigonal planar geometry. Find all the symmetry elements of both point groups.
 D. Explain reducible and irreducible representation. Describe briefly the orthogonality theorem and its consequences.
 E. What is Bragg's Law? Explain the determination of structure of a crystal by powder method.

Q5. Attempt any three of the following:

(3x5=15)

- A. A Cu(II) metal ion ($g_{\text{iso}} = 2.12$) produces four lines with a separation of 500 MHz between each line. Express the hyperfine splitting in field units of mT and the hyperfine coupling in units of wavenumbers. ($I_{\text{Cu(II)}} = 3/2$).
 B. Consider the molecule HPF_2 , explain its ^{31}P NMR spectra under the following conditions:
 (i) $J_{\text{P-F}} > J_{\text{P-H}}$
 (ii) $J_{\text{P-H}} > J_{\text{P-F}}$
 C. Give an account of resonance Raman spectroscopy.
 D. The X-band (9.5 GHz) EPR spectrum of a matrix isolated Na atom reveals four hyperfine lines with resonant field positions of 3074 G, 3174 G, 3274 G and 3374 G. Calculate the g value of the atom.
 E. The Mossbauer spectrum of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ shows a quadrupole doublet while that of $\text{K}_4[\text{Fe}(\text{CN})_6]$ shows a single line. Explain.

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