

RANI RASHMONI GREEN UNIVERSITY
DEPARTMENT OF CHEMISTRY
Semester – I, Final Examination – 2024
M.Sc. Course in Chemistry
Course ID: CHEM-C11

Full Marks: 40

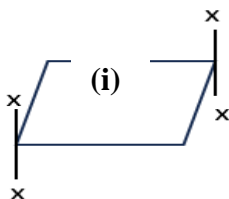
Time: 2 h

Answer **any one** question from **each unit** in your own words with proper scientific justification.

Unit-1: Symmetry and Group Theory

Q-1.(a) Show that the existence of $C_4(z)$ and $\sigma(xz)$ automatically requires that σ_d exist.

(b) List the symmetry elements and determine the point groups of the following:



(ii) Eclipsed configuration of Ferrocene

(c) Prove that the sum of the squares of the characters of any irreducible representation of a group is equal to the order of the group.

[2+3+3 = 8]

Q-2. (a) Show that the order of any subgroup, g , of a group of order, h , must be a divisor of h .

(b) Prove that simultaneous existence of C_n , σ_h and σ_v 's may be the criterion for the existence of the group D_{nh} .

(c) Show how the characters of the irreducible representation of C_{3v} point group can be determined using the 'Great Orthogonality Theorem'?

[2+3+3 = 8]

Unit-2: Coordination Chemistry-1

Q-3.(a) Diagrammatically represent the splitting of the orbitals for the following geometries:

- (i) Tetrahedral
- (ii) Square planar

(iii) Trigonal Bipyramidal

(b) Draw the curve and explain the hydration enthalpies of the dipositive ions of the 3d transition metal.

(c) What type of spinel structure do you expect for Mn_3O_4 and $NiCr_2O_4$? Explain on the basis of CFT.

[3+2+3 = 8]

Q-4. (a) Which of the following high spin complexes would you expect to exhibit Jahn-Teller distortion: $[Cr(NH_3)_6]^{3+}$; $[MnCl_6]^{3-}$; $[Fe(H_2O)_6]^{3+}$. Give reason(s).

(b) What are labile and inert complexes? Identify labile and inert complexes from the

following: $[Ni(H_2O)_6]^{2+}$; $[Co(NH_3)_5(H_2O)]^{3+}$ and $[Cu(H_2O)_6]^{2+}$

(c) 'In spite of more chelating effect in $[Cu(en)_3]^{2+}$ is less stable compared to $[Cu(en)_2(H_2O)_2]^{2+}$ ions'-criticize the fact considering the Jahn-Teller distortion.

(d) Calculate the magnetic moment of the following complexes:(i) $[Ni(CO)_4]$ and (ii) $[Fe(CN)_6]^{4-}$

[2+3+2+1 = 8]

Unit-3: Bioinorganic Chemistry-1

Q-5.(a) Differentiate between active and passive transports through the cell membrane. What type of transport occurred in case of $Na^+ - K^+$ ion pump? Explain your answer. How does this pump function?

(b) How does ceruloplasmin protein correlate to Wilson's disease? How do you distinguish between Wilson's diseases and Menkes disease based on genetic risk factor?

(c) Write down the working principle for the action of a good chelating drug to remove heavy metal poisoning (like Hg, As *etc...*) from human body with proper examples.

[4+2+2 = 8]

Q-6. (a) Why does nature choose 'Zn(II)' among 3d metal ions in hydrolytic enzymes like carbonic anhydrase?

(b) Compare the acidity of Zn(II) in carbonic anhydrase and carboxy peptidase A.

(c) Show the mechanism of action of carbonic anhydrase in our body.

(d) Why *meso*-2,3-dimercapto succinic acid is superior as a chelating drug to 2,3-dimercapto-1-propanol for lewisite poisoning?

[2+2+2+2 = 8]

Unit-4: Solid State Chemistry-1

Q-7.(a) Describe the band theory of metallic bonding.

(b) How impurity causes defect in solids.

(c) How does the volume of a crystal affected by Schottky defects?

[4+2+2 = 8]

Q-8.(a) Describe the expression to calculate the concentration of Frenkel defects in solids.

(b) Define p-type and n-type semiconductors with examples.

[5+3 = 8]

Unit-5: Electrochemical Analyses

Q-9. (a) What is 'Ohmic potential' & write its unit.

(b) How does Ohmic potential can be minimized in an electrochemical cell?

(c) What experimental variables affect concentration polarization in an electrochemical cell?

(d) What is a supporting electrolyte and what is its role in electrochemistry?

[2+2+2+2 = 8]

Q-10. (a) What is voltammogram?

(b) Write the parameters of x- & y-axes used in a typical cyclic-voltammogram.

(c) A constant current of 0.801 A is used to deposit copper at the cathode and oxygen at the anode of an electrolytic cell. Calculate the number of grams of each product formed in 12.5 min, assuming no other redox reaction occurs.

[1+2+5 = 8]