

(7 Pages)

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M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2021.

Fourth Semester

Chemistry — Core

INORGANIC CHEMISTRY — IV

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The Mossbauer spectrum of $^{119}\text{SnCl}_4$ shows no quadrupole splitting, where as that of $^{119}\text{SnF}_4$ exhibits quadrupole splitting. Which of the following statements is correct?
 - (a) SnCl_4 is tetrahedral but SnF_4 is distorted octahedral
 - (b) SnCl_4 has field gradient but SnF_4 has no field gradient
 - (c) Quadrupole splitting is due to higher electronegativity of fluoride
 - (d) None of the above

2. The complex, $[\text{Co}(\text{en})_3]^{3+}$ shows positive cotton effect. What is the absolute configuration?
- (a) $\Lambda - (\text{D}) - [\text{Co}(\text{en})_3]^{3+}$
 - (b) $\Lambda - (\text{D}) - [\text{Co}(\text{en})_3]^{3+}$
 - (c) $\Delta - (\text{L}) - [\text{Co}(\text{en})_3]^{3+}$
 - (d) None of these
3. The 2 p XPS of Cu has two peaks at 952.7 and 932.7 eV due to —————.
- (a) Jahn-Teller distortion
 - (b) Spin-orbit coupling
 - (c) Chemical shift
 - (d) None of the above
4. In XPS, the binding energies of core electrons give rise to chemical shifts. Which of the following statements is true?
- (a) Chemical shift is the same irrespective of the particular core energy level studied
 - (b) For an atom in the same chemical environment, the shift increases with increasing positive charge on the atom
 - (c) The sensitivity of the chemical shift to charge varies roughly as the inverse of the valence shell radius
 - (d) All of the above

5. The cytochromes P-450 are regarded as oxidizing enzymes, yet they consume one equivalent of the reducing agent NADH for each catalytic cycle. Why?
- (a) NADH is required to provide energy to the catalytic cycle
 - (b) NADH is required to oxidize the Fe (II) to iron in the catalytic cycle
 - (c) NADH is required to re-reduce the iron to Fe(II) in the catalytic cycle
 - (d) None of the above
6. The expected exponent for the O_2 in the oxygenation (equilibrium) constant equation for hemoglobin _____.
- (a) 4
 - (b) 2
 - (c) 2.8
 - (d) 4.8
7. Which of the following complexes are used in cancer treatment?
- (a) Carboplatin
 - (b) Oxaliplatin
 - (c) Satraplatin
 - (d) All of these
8. Which of the following copper proteins is involved in oxygen transport?
- (a) Quercetinase
 - (b) Hemocyanin
 - (c) Tyrosinase
 - (d) Blue Cu proteins

9. A large single crystal of silicon is prepared by _____ process.
- (a) Hydrothermal method
 - (b) Czochralski process
 - (c) Sol-gel process
 - (d) Epitaxy method
10. Zeolitic structures with pore sizes of 2000 to 10000 pm are known as mesoporous solids. They can be prepared by
- (a) liquid crystal templating
 - (b) sealed tube method
 - (c) precipitation method
 - (d) none of the above

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Describe the application of Mossbauer spectroscopy in determination of oxidation states and π - bonding.

Or

- (b) Discuss Mossbauer spectrum of the following compounds : $\text{Fe}_2(\text{SO}_4)_3$ (anhydrous) and $\text{K}_4[\text{Fe}(\text{CN})_6]$.

12. (a) What are satellite peaks in XPS? Describe the mechanisms of formation of such peaks. Give their applications in qualitative analysis.

Or

- (b) Describe the applications of photoelectron spectroscopy in explaining the structure and bonding of metal carbonyls.

13. (a) What are siderophores? Discuss the structures any two siderophores.

Or

- (b) Describe the structure and function of cytochrome c.

14. (a) Explain the structural features and function of blue copper proteins.

Or

- (b) How are the following chelating agents can be used therapeutically? Give their mode of actions.

(i) D-penicillamine and

(ii) cis-diamminedichloroplatinum(II)

15. (a) What are zeolites? Explain the structure and properties of zeolites.

Or

- (b) Write a note on fullerenes and fullerides.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Describe the applications of Mossbauer spectroscopy in determination of
- (i) spin state crossover (SCO) and
 - (ii) cis-Trans isomers.

Or

- (b) Describe the application of Mossbauer spectroscopy in confirming the structures of $\text{Fe}_4^{\text{(III)}} [\text{Fe}^{\text{(II)}} (\text{CN})_6]_3$, Ferridoxin ($\text{Fe}_4\text{S}_4(\text{SCys})_4$) and $\text{Fe}_3(\text{CO})_{12}$.
17. (a) What is the origin of vibrationaal fine structures of PES? With examples illustrate its useful in identifying the nature of the molecular orbitals, predissociation and Jahn-Teller distortion.

Or

- (b) Discuss the photoelectron spectra of the following molecules :
- (i) N(1s) XPS of $[\text{Co}(\text{en})_2(\text{NO}_2)_2]\text{NO}_3$ and C(1s) XPS of CCl_3CH_3 .
 - (ii) UV-PES of NH_3 and CO_2 .

18. (a) What are metalloporphyrins? Explain the structure and functions of hemoglobin.

Or

- (b) Discuss the structure, redox properties and biological functions of vitamin B₁₂.

19. (a) Write a brief account of :

(i) Inhibition and poisoning of enzyme action

(ii) Chelate therapy.

Or

- (b) Discuss the structure and role of superoxide dismutase.

20. (a) Discuss the structures and properties of pillared clays.

Or

- (b) Explain the epitaxy, chemical vapour transport and solution methods for the preparation of single crystals with suitable examples.
