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Reg. No. : .....

Code No. : 7832 **Sub. Code : WCHM 32**

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2024.

Third Semester

Chemistry — Core

COORDINATION CHEMISTRY — I

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. The spectrochemical series is an arrangement of ligands based on

   (a) Their color

   (b) Their size

   (c) Their ability to split d-orbital energies

   (d) Their magnetic properties

2. Which complex is expected to show Jahn-teller distortion?

   (a) $[Co(NH_3)_6]^{3+}$ (b) $[Mn(H_2O)_6]^{2+}$

   (c) $[Cu(NH_3)_6]^{2+}$ (d) $[Ni(H_2O)_6]^{2+}$

3. In tetrahedral coordination complexes, the d-orbitals split into

   (a) t_2 and e (b) e_g and e_u

   (c) t_{2g} and eg (d) e and e t_{1g}

4. Which term symbol corresponds to the ground state of a d^2 ion?

   (a) ^3F (b) ^2D

   (c) ^1S (d) ^3P

5. The Tanabe-Sugano diagram is used to find the energy difference between

   (a) Two different metal ions

   (b) Two different ligands

   (c) Spin-allowed and spin-forbidden transitions

   (d) High-spin and low-spin states in a given configuration

6. Magnetic movement values can be used to distinguish between

(a) Oh and Td complexes

(b) Square planar and tetrahedral complexes

(c) High-spin and low-spin complexes

(d) All of the above

7. Which of the following is true for inert complexes?

(a) They undergo rapid ligand substitution

(b) They have low activation energy for ligand exchange

(c) They exhibit slow ligand substitution

(d) They are highly reactive

8. The macrocyclic effect refers to the increased stability of complexes formed by

(a) Large ligands

(b) Chelating ligands

(c) Ligands forming cyclic structures

(d) Monodentate ligands

9. The determination of stability constant by polarographic method involves measuring

(a) Electrode potential

(b) Current as a function of applied voltage

(c) Absorbance of the complex

(d) The solubility of the complex

10. The dissociative (S_N1) mechanism in coordination complexes is characterized by

(a) Simultaneous bond formation and bond cleavage

(b) Formation of a five-coordinate transition state

(c) The rate-determining step involves loss of a ligand

(d) Involves nucleophilic attack as the first step

11. Which of the following ligands will most likely cause a high trans effect in a square planar complex?

(a) OH^- (b) CN^-

(c) NH_3 (d) H_2O

12. Which of the following tests is used to distinguish between cis and trans isomers of square planar complexes?

(a) Kurnakov test (b) Beilstein test

(c) Silver mirror test (d) Benedict's test

13. According to the Marcus-Hush theory, the rate of electron transfer depends on which of the following factors?

(a) Free energy change of the reaction

(b) Distance between donor and acceptor

(c) Reorganization energy

(d) All of the above

14. The term "thexi states" refers to

(a) Ground state of a complex

(b) Excited state of a complex

(c) Transition state in a reaction

(d) Intermediate in electron transfer

15. The photophysical properties of $[Ru(bpy)_3]^{2+}$ are primarily due to

(a) Metal-centered transitions

(b) Ligand-centered transitions

(c) Metal-to-ligand charge transfer (MLCT)

(d) Ligand-to-metal charge transfer (LMCT)

PART B — ($5 \times 4 = 20$ marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 250 words.

16. (a) Describe the process of calculating crystal field stabilization energy (CFSE) for a d^4 high-spin octahedral complex.

Or

(b) Discuss the factors that influence the crystal field splitting energy in square planar complexes.

17. (a) What are charge transfer spectra, and how do they differ from d-d transitions?

Or

(b) Discuss the magnetic properties of Lanthanides.

18. (a) Explain the concept of inert and labile complexes with examples.

Or

(b) Discuss the macrocyclic effect and provide an example of a macrocyclic ligand.

19. (a) Discuss the factors that influence the rate of acid hydrolysis of octahedral complexes.

Or

(b) What is the role of activation energy in determining the rate of ligand substitution in coordination complexes?

20. (a) Differentiate between inner sphere and outer sphere electron transfer reactions.

Or

(b) Describe the mechanism of photo-substitution reactions in Co(III) complexes.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

21. (a) Describe the spitting of d-orbitals in tetrahedral coordination complexes and compare it with octahedral splitting.

Or

(b) What are the consequences of Jahn-Teller distortions in coordination complexes?

22. (a) Discuss the role of Racah parameters in understanding the electronic structure and magnetic properties of transition metal complexes.

Or

(b) Explain the magnetic properties of complexes with A, E and T terms.

23. (a) What factors contribute to kinetic lability of a complex? Explain.

Or

(b) (i) What are stepwise formation constants, and how are they related to overall formation.

(ii) Describe the concept of chelate effect and its impact on complex stability.

24. (a) Discuss the factors that influence whether a substitution reaction in a octahedral complex follows S_N1 or S_N2 mechanism.

Or

(b) Explain the theories of trans effect and their applications.

25. (a) What are complementary and non-complementary electron transfer reactions? Explain with examples.

Or

(b) How does photochemcial conversion of N_2 to NH_3 occur?

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