STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI-86
(For candidates admitted during the academic year 2019-20 & thereafter)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2023
BRANCH IV- CHEMISTRY
THIRD SEMESTER

COURSE : CORE
PAPER : COORDINATION CHEMISTRY
SUBJECT CODE : 19CH/PC/CO34
TIME : 3 HOURS **MAX.MARKS :100**

SECTION – A **(20x1=20)**

Answer all the questions:
Choose the correct answer:

1. The colour of the complex $[Fe(bpy)]^{2+}$arised due to
   a) d-d transitions
   b) due to charge transfer from ligand bpy to Fe orbitals
   c) due to charge transfer from $Fe^{2+}$to π* orbitals of bpy ligand
   d) due to charge transfer from π* orbitals of bpy ligand to the orbitals of Fe^{2+}

2. Give a reason for the statement. '$[Ni(CN)_4]^{2-}$ is diamagnetic while $[NiCl_4]^{2-}$ is paramagnetic in nature.'
   a) In $[NiCl_4]^{2-}$, no unpaired electrons are present while in $[Ni(CN)_4]^{2-}$ two unpaired electrons are present.
   b) In $[Ni(CN)_4]^{2-}$, no unpaired electrons are present while in $[NiCl_4]^{2-}$ two unpaired electrons are present.
   c) $[NiCl_4]^{2-}$ shows dsp^2 hybridization hence it is paramagnetic.
   d) $[Ni(CN)_4]^{2-}$ shows sp^3 hybridization hence it is diamagnetic.

3. Among the following compounds which are both paramagnetic and coloured?
   a) $K_2Cr_2O_7$ b) $[Co(SO)_4]$ c) $(NH_4)_2[TiCl_6]$ d) $K_3[Cu(CN)_4]$

4. IUPAC name of $[Pt(NH_3)_2Cl(NO_2)]$ is
   a) Platinum diamminechloronitrite b) Chloronitrito-N-ammineplatinum (II)
   c) Diamminechloridonitrito-N-platinum (II) d) Diamminechloronitrito-N-plantinate (II)

5. The type of isomerism shown by the complex $[CoCl_2(en)_2]$ is
   a) Geometrical isomerism b) Coordination isomerism
   c) Linkage isomerism d) Ionization isomerism

6. Magnetic measurements indicate that $[Co(H_2O)_6]^{2+}$ has 3 unpaired electrons. Therefore, the hybridization of the metal's orbitals in $[Co(H_2O)_6]^{2+}$ is:
   a) sp^3 b) sp^2d c) dsp^2 d) sp^3d^2

7. In which one of the following species does the transition metal ion have d^3 electronic configuration?
   a) $[Cr(NH_3)_6]^{3+}$ b) $[Co(OH_2)_6]^{2+}$ c) $[CoF_6]^{3-}$ d) $[Fe(CN)_6]^{3-}$

8. Which one of the following statements is FALSE?
   a) In an octahedral crystal field, the d electrons on a metal ion occupy the e_g set of orbitals before they occupy the t_{2g} set of orbitals.
   b) Diamagnetic metal ions cannot have an odd number of electrons.
   c) Low spin complexes can be paramagnetic.
   d) In high spin octahedral complexes, Δ_{oct} is less than the electron pairing energy, and is relatively very small.

9. The correct order of field strength among the ligands NH_3, en, CN, and CO is
   a) $NH_3 < en < CN^- < CO$ b) $CN^- < NH_3 < CO < en$
   c) $en < CN^- < NH_3 < CO$ d) $CO < NH_3 < en < CN^-$

10. Which of the following has magnesium?
    a) Chlorophyll b) Haemocyanin c) Carbonic anhydrase d) Vitamin B_{12}

11. Which of the following shall form an octahedral complex?
    a) d^4 (low spin) b) d^8 (high spin) c) d^6 (low spin) d) All of these

12. Pick out the correct statement with respect to $[Mn(CN)_4J^{2-}$
    a) It is sp^2d^2 hybridised, tetrahedral b) It is d^2sp3 hybridised, octahedral
    c) It is dsp^2 hybridised, square planar d) It is $sp3d^2$ hybridised octahedral

13. Acid hydrolysis of octahedral complexes proceeds by:
    a) SE1 b) SE2 c) SN1 d) SN2

14. Which of the following ions has high magnetic moment?
    a) Cr^{3+} b) Mn^{2+} c) Cu^{2+} d) Co^{3+}

Answer in one or two sentences:

15. Give the structure of Vitamin B12
16. What is nephlauxetic effect?
17. Give one evidence for metal ligand orbital overlap
18. How many d-d bands would be expected in the electronic spectrum of an octahedral Cr(III) complex?
19. Electronic absorption spectra of lanthanide ions are very sharp. Why?
20. Derive the ground term symbol for octahedral Cr^{3+} ion.

SECTION – B

Answer any five questions: **(5x8=40)**

21. a) What are the limitations of V.B. Theory.
    b) Explain the optical isomerism of 6 coordination complexes.

22. a) Explain the principle of MB spectroscopy and its application for the study of tin compounds
    b) Explain the ESR Spectra of Copper complexes – $[Cu(en)_3]^{2}$

23. a) Explain why $Mn(CO)_5$ is paramagnetic while $Mn_2(CO)_{10}$ is diamagnetic
    b) Write short notes on spin orbit coupling

24. a) Discuss about the substitution reaction involved in octahedral complex with an example.
    b) What is trans effect? Explain with suitable theory.

25. Write short notes on Rubredoxins and Ferredoxins.

26. Distinguish photo substitution and photo isomerization of cobalt complexes. (4+4)

27. Discuss the electronic spectra of lanthanide and actinide complexes. (4+4)

SECTION – C

Answer any Two questions. (2x20=40)

28. a) Write short notes on (a) Spectro chemical series and (b) LCAO method
    b) Discuss the factors affecting the reactivity of square planar complexes of d^8 metal ions.
    c) What is Bohr effect in haemoglobin?
    d) Explain the terms: (a) Spectra of strong-field ligand complexes (b) Jahn-Teller distortion. (6+6+4+4)

29. a) With the Term symbols, draw the Orgel diagram for d^2 octahedral, d^4 tetrahedral complexes.
    b) Discuss the effect of temperature on the magnetic susceptibility of transition metal complexes
    c) Explain the Taube mechanism of inner sphere electron transfer reaction in metal complexes
    d) Describe the structural aspects and functions of haemoglobin. (6+4+6+4)

30. a) Explain the trans effect in square planar complex.
    b) What is Na^+ /K^+ pump? How does it function?
    c) Discuss the structure and function of metallo porphyrin in the transport and storage of oxygen with hemoglobin as an example.
    d) Draw the Tanabe-Sugano diagram for a d^3 complex (4+6+6+4)

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