STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 86
(For candidates admitted from the academic year 2023 – 2024 & thereafter)

M. Sc. DEGREE EXAMINATION, APRIL 2026
BRANCH IV- CHEMISTRY
SECOND SEMESTER

COURSE : CORE
PAPER : COORDINATION CHEMISTRY
SUBJECT CODE : 23CH/PC/CO24
TIME : 3 HOURS MAX. MARKS: 100

Q. No.	SECTION A **Choose the correct answer. (10 x 1 = 10 marks)**	CO	KL
1.	The number of possible isomers of a square planar complex [Mabcd] is a) 1 b) 2 c) 3 d) 4	1	1
2.	The formula for a complex formed in brown ring test for the detection nitrate ion in qualitative analysis is a) $[Fe(H_2O)_5 NO]SO_4$ b) $[Fe(H_2O)_5 (SCN)]SO_4$ c) $[Fe(NH_3)_5 NO]SO_4$ d) $[Fe(H_2O)_4 (NH_3)NO]SO_4$	1	1
3.	In octahedral complex for sigma donor ligands the metal 'd' orbital which is non-bonding in nature is/are a) a_{1g}, t_{2g} b) t_{1u}, t_{2g} c) a_{1g}, e_g d) t_{2g}	1	1
4.	In tetrahedral complex for sigma donor ligands the metal 'd' orbital which is non-bonding in nature is/are a) a_1, t_2 b) t_1, t_2 c) e d) t_2	1	1
5.	Number of chelate rings present in $[Ni(HDMG)_2]$ (including H-bonded chelate) a) 1 b) 2 c) 3 d) 4	1	1
6.	At low temperature the complex $[NiCl_2(PPh_3)_2]$, is a) square planar, diamagnetic b) square planar, paramagnetic c) tetrahedral, diamagnetic d) tetrahedral, diamagnetic	1	1
7.	The type of isomerism exhibited by nitropentammine chromium (III) chloride is a) Linkage isomerism b) ionization isomerism c) optical isomerism d) hydrate isomerism	1	1
8.	The ground state term symbol for Sm(III) ion is a) $^6H_{5/2}$ b) $^6H_{7/2}$ c) $^6H_{3/2}$ d) $^5H_{7/2}$	1	1
9.	The μ_{obs} of $[MnBr_4]^{2-}$ is 5.9 B.M. The number of unpaired electrons are a) 2 b) 3 c) 4 d) 5	1	1
10.	The reaction of $[Ni(CO)_4]$ with the ligand L (L= PMe_3) yields $[Ni(CO)_3 L]$. The reaction is a) Associate b) Dissociative c) I_a d) I_d	1	1

Q. No.	SECTION B Answer ALL the questions. (10 x 1 = 10 marks)	CO	KL
	Fill in the blanks.		
11.	CFSE of $[Co(H_2O)_6]^{3+}$ is ----------	2	2
12.	Fe_3O_4 is an example of ---------- spinel.	2	2
13.	ESR requires higher energy than NMR because ---------	2	2
14.	Magnetism in permanganate is due to --------	2	2
15.	d1(octahedral) is kinetically -------- in nature	2	2
	Answer in a line or two.		
16.	Why Fluoride is weaker ligand than water?	2	2
17.	What is mean by nephelauxetic effect?	2	2
18.	Why $\mu_{observed} \neq \mu_{calculated}$ in the case of Sm(III) and Eu(III)?	2	2
19.	What is mean by reorganization energy?	2	2
20.	Compare the magnetic property of oxy and deoxy-hemoglobin.	2	2
Q. No.	**SECTION C** **Answer any FOUR questions. (4 x 6 = 24 marks)**	**CO**	**KL**
21.	a) Draw the possible stereoisomers for the octahedral complex $[Ma_2b_2cd]$ where a, b, d and c represents monodentate ligands. (4) b) What are flexidentate ligands? Give examples. (2)	3	3
22.	Explain the ESR spectrum of bis(salicyaldimine)Copper (II). Why the total number of lines are reduced in the real spectrum?	3	3
23.	Calculate the μ_{so} and μ_{L+S} values for $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$ and $[TiCl_4]^{3-}$. (3x2)	3	3
24.	a) The complex $[Cr(H_2O)_6]^{2+}$ is labile, but the complex $[Cr(CN)_6]^{4-}$ is inert. Explain. (3) b) The rate of aquation of *cis*-$[Co(en)_2(OH)Cl]^{+}$ is faster than *cis*-$[Co(en)_2(NH_3)Cl]^{2+}$. How does it happen? (3)	3	3
25.	Describe the biological functions of haemoglobin and myoglobin. (3+3)	3	3
Q. No.	**SECTION D** **Answer any FOUR questions. (4 x 8 = 32 marks)**	**CO**	**KL**
26.	a) The observed lattice energy of octahedrally coordinated crystals of FeO is -3923 kJ/mol. The lattice energy of the crystal in the absence of CFSE is found to be -3856 kJ/mol. Calculate CFSE of FeO. (3) b) Why CO is considered as strong ligand than ammonia? (2) c) Is it true that pi-donor ligands are pi-acceptor in nature? Justify your answer. (3)	4	4
27.	a) The electronic spectrum of $[CrF_6]^{3-}$ shows three bands at 14,900, 22,400 and 34,800 cm^{-1}. Calculate the Δ_o of the complex. (2) b) Discuss the spectra of d^1 and d^9 ions in octahedral and tetrahedral complexes. (3+3)	4	4
28.	Predict the magnetic moments of the following complexes: (4x2) i) $[Cr(H_2O)_6]^{2+}$ ii) $[Cr(CN)_6]^{4-}$ iii) $[Ni(CO)_4]$ iv) $[NiCl_4]^{2-}$	4	4

29.	a) In the following redox reaction with Kequ = 2.0 x10^8. $[Ru(NH_3)_6]^{2+}$+ $[Fe(H_2O)_6]^{3+}$ ==== $[Ru(NH_3)_6]^{3+}$+ $[Fe(H_2O)_6]^{2+}$ The self-exchange rates for the oxidant and reductant are 5.0 M^{-1}/s and 4000 M^{-1}/s respectively. Calculate the rate constant for the above reaction. (4) b) Aqueous Cr(II) effects one electron reduction of $[Co(NH_3)_5Cl]^{2+}$ giving compound X. The compound X undergo rapid hydrolysis in to Y. Predict the compounds X and Y. (4)	4	4
30.	a) Outline the biological importance of trace elements. (4) b) Explain the important functions of Rubredoxin and Ferredoxin. (4)	4	4
Q. No.	**SECTION E** **Answer the following questions. (2 x 12 = 24 marks)**	**CO**	**KL**
31.	a) Explain the following: (3x2) i) The macrocyclic effect; ii) The outer orbital octahedral complex are labile; iii) The inner orbital octahedral complex containing at least one empty 'd' atomic orbital in the t2g set are labile. b) Arrange the following complexes in the order increasing Δ_o. (3) $[Cr(H_2O)_6]^{+2}$; $[Rh(H_2O)_6]^{+3}$; $[Co(H_2O)_6]^{+3}$; $[Ir(H_2O)_6]^{+3}$; $[Fe(H_2O)_6]^{+2}$ c) The observed Δ_o is greater than the paring energy for the complex of Rh(II). Calculate its CFSE and pairing energy. (3)	5	5
	(OR)		
32.	a) Predict the ground state terms for the following configurations: (8) i) d_8 (Oct. field); ii) high spin and low spin d^5 (oct.field); iii) high spin and low spin d^4 (oct field) b) Draw the Orgel diagram for V(III) (aqu) and Cr(III) (aqu). Give the number of transitions with its assignment and energy involved in it. (4)		
33.	a) Discuss the magnetic behavior of $[CoCl_4]^{2-}$ and $Co(H_2O)_6]^{2+}$. (4) b) How do you explain the fact that d^2 and d^8 configuration have same general ground state term but not the same J value? (4) c) $\mu_{observed}$ for $[NiCl_4]^{2-}$ is 2.83 BM, whereas $[PdCl_4]^{2-}$ is zero BM, but both will have same number of 'd' electrons. Explain. (4)	5	5
	(OR)		
34.	a) Compare the rate of hydrolysis reactions: (3x2) i) Neutral hydrolysis: $[Co(NH_3)_5 X]^{2+}$(Where X= F, Cl, Br, I) ii) Acid hydrolysis: $[Co(NH_3)_5 X]^{2+}$(Where X= F, Cl, Br, I) iii) Neutral hydrolysis: $[Ir(NH_3)_5 X]^{2+}$ (Where X= F, Cl, Br, I) b) Predict the product A ,B and justify your answer. (3) $[Cr(H_2O)_6]^{2+}$ + $[Co(NH_3)_5 Cl]^{2+}$ -------- A + B c) Predict the product C , D and justify your answer. (3) $[Cr(H_2O)_6]^{2+}$ + $[Rh(NH_3)_5 Cl]^{2+}$ ------- C + D	5	5

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