



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY**

(MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

SUPPLEMENTARY / SPECIAL EXAMINATION

2021 / 2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE OF
BACHELOR OF SCIENCE (CHEMISTRY) AND BACHELOR
OF INDUSTRIAL CHEMISTRY**

COURSE CODE: SCH 318

**COURSE TITLE: INORGANIC REACTION MECHANISMS OF
COMPLEX COMPOUNDS**

DATE: 04/08/2022

TIME: 8.00-10.00 AM

INSTRUCTIONS TO CANDIDATES

Total Marks: 70

Answer all the Questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (18 Marks)

- (a) Name the following complex ions/coordination complexes:
- (i) $[\text{Ag}(\text{NH}_3)_2][\text{Ag}(\text{CN})_2]$ (2 marks)
 - (ii) $[\text{CoCl}_2(\text{en})_2]^+$ (2 marks)
 - (iii) $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$ (2 marks)
- (b) (i) Define *trans*-influence (2 marks)
- (ii) Differentiate between associative and dissociative mechanisms and derive their respective rate laws under steady state approximation (6 marks)
- (c) Draw the structures of the following compounds:
- (i) Optical isomers of *cis*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (2 marks)
 - (ii) Geometric isomers of $[\text{ML}_4\text{X}_2]$ (2 marks)

QUESTION TWO (18 Marks)

- (a) A chelate effect is an entropy factor discuss (6 marks)
- (b) State any four differences between SN^1 reaction and SN^2 reaction (4 marks)
- (c) With an example of each explain:
- (i) Complementary reaction (2 marks)
 - (ii) Non-complementary reaction (2 marks)
- (d) Explain how polarization theory has a *trans* effect in square planar substitution reactions (4 marks)

QUESTION THREE (16 Marks)

- (a) Given the complex PtL_3X reacts with nucleophile Y, show the two pathway mechanisms where one is solvent mediated [Y] not in rate determining step and second pathway [Y] involved in rate determining step (4 marks)
- (b) Explain why octahedral complexes $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ readily undergoes substitution while $[\text{Cr}(\text{CN})_6]^{4-}$ is inert to substitution. (4 marks)
- (c) Transition metal complexes undergo ligand substitution reactions by either associative (A) or dissociative (D) mechanisms. Show the reaction mechanism for each of the following reactions
- (i) $[\text{PtCl}_4]^{2-} + \text{NH}_3 \rightarrow [\text{PtCl}_3(\text{NH}_3)]^- + \text{Cl}^-$ (A mechanism) (2 marks)
 - (ii) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+} + \text{H}_2\text{O} \rightarrow [\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]^{3+} + \text{Cl}^-$ (D mechanism) (2 marks)
 - (iii) Using activation parameters like ΔH , ΔS and ΔV show how you will differentiate associative from dissociative mechanism (4 marks)

QUESTION FOUR (18 Marks)

- (a) Explain how you will distinguish the inner sphere electron transfer reaction from outer sphere electron transfer reaction (4 marks)
- (b) State two factors that favours dissociative mechanism in octahedral complexes (2 marks)
- (c) Explain why the electron transfer reaction of $[\text{Fe}(\text{CN})_6]^{4-}/[\text{Fe}(\text{CN})_6]^{3-}$ is faster than $[\text{Co}(\text{NH}_3)_6]^{2+}/[\text{Co}(\text{NH}_3)_6]^{3+}$ (3 marks)
- (d) State any three applications of coordination complexes (3 marks)
- (e) Draw the following coordination complexes:
- (i) Bis(en)Co(III)- μ -amido- μ -hydroxobis(en)Co(III) (2 marks)
 - (ii) Diaquadiiododinitritopalladium(IV) (2 marks)
 - (iii) Enantiomers of $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ (2 marks)

**Periodic Table
of the
Elements 2006**

																		13	14	15	16	17	18
																		5	6	7	8	9	10
																		B	C	N	O	F	Ne
																		10.81	12.01	14.01	15.99	19.00	20.18
																		13	14	15	16	17	18
																		Al	Si	P	S	Cl	Ar
																		26.98	28.09	30.97	32.07	35.45	39.95
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
H	He															He							
1.01	4.00															4.00							
3	4															5	6	7	8	9	10		
Li	Be															B	C	N	O	F	Ne		
6.94	9.01															10.81	12.01	14.01	15.99	19.00	20.18		
11	12															13	14	15	16	17	18		
Na	Mg															Al	Si	P	S	Cl	Ar		
22.99	24.31															26.98	28.09	30.97	32.07	35.45	39.95		
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
39.10	40.08	44.96	47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.41	69.72	72.64	74.92	78.96	79.90	83.80						
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54						
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.60	126.90	131.29						
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72						
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
132.91	137.33	138.91	178.49	180.95	182.94	186.21	190.23	192.22	195.08	196.97	200.59	204.38	207.2	208.98	(209)	(210)	(222)						
87	88	89	104	105	106	107	108	109	110	111													
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg													
(223)	(226)	(227)	(261)	(262)	(265)	(264)	(270)	(268)	(281)	(272)													
58	59	60	61	62	63	64	65	66	67	68	69	70	71										
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu										
140.12	140.91	144.24	(145)	150.36	151.97	157.25	158.93	162.50	164.93	167.26	168.93	173.04	174.97										
90	91	92	93	94	95	96	97	98	99	100	101	102	103										
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr										
232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)										