



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS 2017/2018 ACADEMIC YEAR THIRD YEAR SECOND SEMESTER

SCHOOL OF SCIENCE AND INFORMATION SCIENCES BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: CHE 318

COURSE TITLE: COORDINATION AND

ORGANOMETALLIC CHEMISTRY

DATE: 20TH AUGUST 2018

TIME: 2:30 PM – 4:30 PM

INSTRUCTIONS TO CANDIDATES

Answer question ONE and any other TWO.

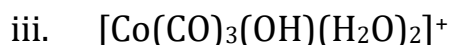
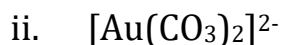
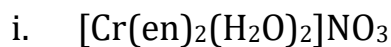
This paper consists of 5 printed pages. Please turn over:

SECTION A

QUESTION ONE

1)

a) Provide the names for the coordination compounds. (6 marks)



b) Provide the chemical formulas for the coordination compounds. (6 marks)

i. tetraammineplatinum(II) difluorotetrachloroplatinate(IV)

ii. diamminediaquadithiocyanatochromium(III) bromide

iii. tris(ethylenediamine)iron(III) hexacyanocobaltate(III)

2) Define each of the following. (3 marks)

i. Ionization isomerism (and give an example)

ii. Crystal field splitting

iii. Hard acid (and give an example)

3) The complex ion $[\text{Cu}(\text{NH}_3)_6]^{2+}$ is blue in aqueous solution. The absorbance spectrum of this complex ion has a maximum absorbance at 615 nm. Calculate the crystal field splitting energy (in kJ/mol) for this ion. (4 marks)

4) Answer the question for each pair of molecules or species and briefly explain why this is the case.

i. Which of the following complexes would demonstrate the greatest magnetism? $[\text{Ru}(\text{CN})_3(\text{H}_2\text{O})_3]^-$ or $[\text{Ru}(\text{Cl})_3(\text{H}_2\text{O})_3]^-$
(3 marks)

ii. Which of the following will form the most stable adduct with Au^+ ?
(2 marks)

F^- Cl^- Br^- I^-

iii. Which of the following is expected to have the largest Δ_0 ? Co^{2+} or Co^{3+} . Explain your reasoning
(2 marks)

5) Briefly explain the advantages of polymerization with Ziegler-Natta catalysts over free-radical polymerization.
(2 marks)

6) Explain why tetrahedral complexes of Co^{2+} are generally more stable than those of Ni^{2+} .
(2 marks)

QUESTION TWO

1) Write the formula or structure as stated and indicate the overall charge.
(12 marks)

a) The structure for: *cis*-dichlorobis(ethylenediamine)chromium(III)

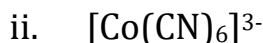
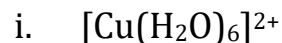
b) The two structures for the isomers of: triaquatrchlorochromate(III) and label them

c) The formula of: μ -amido- μ -hydroxobis(tetracarbonyliron)(4+)

d) The formula of coordination isomer of:

hexaaquairon(III) hexacyanocobaltate(III)

2) Determine the ligand field stabilization energy for the following octahedral complexes and identify the complex ion that is more stable? (4 marks)



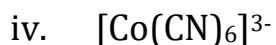
3) Briefly explain why:

i. CuI is much less soluble in water than CuF , and LiF is much less soluble than LiI . (2 marks)

ii. $\text{H}_2\text{N}(\text{CH}_2)_2\text{NH}_2$ forms a more stable complex with Zn^{2+} than $\text{H}_2\text{N}(\text{CH}_2)_5\text{NH}_2$ (2 marks)

QUESTION THREE

1) Draw the octahedral crystal field splitting diagram for metal ions in the following complex ions and in each case, indicate whether it is diamagnetic or paramagnetic: (8 marks)



2) The complex $[\text{Fe}(\text{LG})_6]^{2+}$ is known to be diamagnetic. Given that LG is a neutral monodentate ligand, is LG ligand inducing a strong field or weak field? Show your reasoning. (3 marks)

3) Identify the most likely transition metal **M**: (9 marks)

i. $\text{K}_3[\text{M}(\text{CN})_6]$, in which **M** is a first-row transition metal and the complex has three unpaired electrons

ii. $[\text{M}(\text{H}_2\text{O})_6]^{3+}$, in which **M** is a second-row transition metal and $\text{LFSE} = -2.4 \Delta_o$

iii. tetrahedral $[\text{MCl}_4]^-$, which has five unpaired electrons and first-row transition metal **M**

QUESTION FOUR

- 1) Predict the number of unpaired electrons for each of the following: (8 marks)
- a tetrahedral d^6 ion
 - $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ in octahedral field
 - $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ in octahedral field
 - a square-planar d^7 ion
- 2) Identify the first-row transition metal for the following 18-electron species: (6 marks)
- $[\text{M}(\text{CO})_3(\text{PPh}_3)]^-$
 - $\text{HM}(\text{CO})_5$
 - $[(\eta^5\text{-C}_5\text{H}_5)\text{M}(\text{CO})_3]_2$ (assume single **M-M** bond)
- 4) For each of the following complexes, determine the hybrid orbital type and the number of unpaired electrons. (6 marks)
- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$
- (b) $[\text{Co}(\text{CN})_6]^{3-}$

The Periodic Table of Elements

Periods																									
1	2	3	4	5	6	7																			
1A 1	2A 2																			3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1 H	2 He											5 B	6 C	7 N	8 O	9 F	10 Ne								
3 Li	4 Be											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar								
11 Na	12 Mg	3B 3	4B 4	5B 5	6B 6	7B 7	8 8	9 9	10 10	11 11	12 12	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr								
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe								
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn								
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	113 In	114 Pb	115 Bi	116 Po	117 Ts	118 Og								
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og								

	 Metals	 Metalloids	 Nonmetals
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Lanthanides	Actinides																																																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: right;">58</td><td>Ce</td></tr> <tr><td style="text-align: right;">59</td><td>Pr</td></tr> <tr><td style="text-align: right;">60</td><td>Nd</td></tr> <tr><td style="text-align: right;">61</td><td>Pm</td></tr> <tr><td style="text-align: right;">62</td><td>Sm</td></tr> <tr><td style="text-align: right;">63</td><td>Eu</td></tr> <tr><td style="text-align: right;">64</td><td>Gd</td></tr> <tr><td style="text-align: right;">65</td><td>Tb</td></tr> <tr><td style="text-align: right;">66</td><td>Dy</td></tr> <tr><td style="text-align: right;">67</td><td>Ho</td></tr> <tr><td style="text-align: right;">68</td><td>Er</td></tr> <tr><td style="text-align: right;">69</td><td>Tm</td></tr> <tr><td style="text-align: right;">70</td><td>Yb</td></tr> <tr><td style="text-align: right;">71</td><td>Lu</td></tr> </table>	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: right;">90</td><td>Th</td></tr> <tr><td style="text-align: right;">91</td><td>Pa</td></tr> <tr><td style="text-align: right;">92</td><td>U</td></tr> <tr><td style="text-align: right;">93</td><td>Np</td></tr> <tr><td style="text-align: right;">94</td><td>Pu</td></tr> <tr><td style="text-align: right;">95</td><td>Am</td></tr> <tr><td style="text-align: right;">96</td><td>Cm</td></tr> <tr><td style="text-align: right;">97</td><td>Bk</td></tr> <tr><td style="text-align: right;">98</td><td>Cf</td></tr> <tr><td style="text-align: right;">99</td><td>Es</td></tr> <tr><td style="text-align: right;">100</td><td>Fm</td></tr> <tr><td style="text-align: right;">101</td><td>Md</td></tr> <tr><td style="text-align: right;">102</td><td>No</td></tr> <tr><td style="text-align: right;">103</td><td>Lr</td></tr> </table>	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr
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