

CHUKA



UNIVERSITY

**UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE**

CHEM 313: COORDINATION CHEMISTRY

STREAMS:

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 11/08/2021

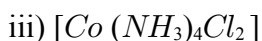
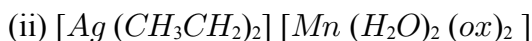
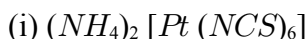
8.30 A.M - 10.30 A.M.

INSTRUCTIONS

- Answer question one and any other two questions.

QUESTION ONE (30 MARKS)

(a) Write the systematic names of the following complexes. [5 marks]



(b) Discuss bonding and magnetism of $[(NH_3)_6]^{2+}$ using the valence bond theory [4 marks] (b)

Explain the following observations:

(i) $[FeF_6]^{3-}$ is colourless whereas $[CoF_6]^{3-}$ is coloured but exhibits only a single band in the visible. [2 marks]

(ii) Solutions of $[(H_2O)_6]^{3+}$ ions are pale blue-green but the chromate ion, CrO_4^{2-} is an intense yellow [2 marks]

(c) Draw a well labeled diagram of the splitting of d-orbitals in:

(i) Octahedral field. [2 marks]

(ii) Tetrahedral field [2 marks]

(iii) Square planar field [2 marks]

(d) Discuss the effects of d-orbital splitting on the ionic radii of divalent ions of the first row transition elements. [6 marks]

(e) Write the structural formula of each of the following complexes. [5 marks]

(i) Hexaammine chromium(III) bromide

(ii) Potassium tetracyanonickelate (II)

(iii) Tetraamine chromium (III) - μ - amido- μ -hydroxobis (ethylenediammine) iron (III) sulphate.

(iv) Hexaammine cobalt (III) pentachlorocuprate (II)

(v) Bariumdibromodioxolatocobaltate (III)

QUESTION TWO (20 MARKS)

(b) Draw the structures of and name all the stereoisomers of: [6 marks]

(i) $[(NH_3)_2Cl_2]$

(ii) $[Co(en)_2Cl_2]^+$

(c) The crystal field splittings, Δ , of four chromium complexes are listed in the table below. Explain the differences in values. [5 marks]

Complex	$\Delta (cm^{-1})$
$[Cr F_6]^{3-}$	15000
$[Cr(OH_2)_6]^{3+}$	17,400
$[Cr(F_6)]^{2-}$	22,000
$[Cr(CN)_6]$	26,600

d) Three hydrates of chromium (iii) chloride are known: form A is hexahydrate; form B is pentahydrate; and form C is tetrahydrate. Addition of excess silver ion solution 1 mole of each form results in precipitation of the following number of moles of silver chloride: from A-3; from

B-2; from C-1. Using this information deduce the actual structure of each hydrate and write the corresponding name. [6 marks]

(e) Determine the Russel-saunders terms for the $3P^2$ configuration and identify the ground state term. [3 marks]

QUESTION TWO (20 MARKS)

(a) Discuss bonding and magnetism of $[(NH_3)_6]^{2+}$ using the valence bond theory. [4 marks]

(b) Explain the following observations:

(i) $[FeF_6]^{3-}$ is colourless whereas $[CoF_6]^{3-}$ is coloured but exhibits only a single band in the visible. [2 marks]

(ii) Solutions of $[(H_2O)_6]^{3+}$ ions are pale blue-green but the chromate ion, CrO_4^{2-} is an intense yellow. [2 marks]

(c) Draw a well labeled diagram of the splitting of d-orbitals in:

(i) Octahedral field. [2 marks]

(ii) Tetrahedral field [2 marks]

(iii) Square planar field [2 marks]

(d) Discuss the effects of d-orbital splitting on the ionic radii of divalent ions of the first row transition elements. [6 marks]

QUESTION THREE (20 MARKS)

(a) Draw an Orgel diagram for $[(H_2O)_6]^{3+}$ and label the possible transitions. [3 marks]

(b) (i) State the selection rules for electronic transitions. [2 marks]

(ii) Sketch the electronic spectrum of $[Cr (NH_3)_6]^{3+}$ and give the transition corresponding to each peak. [4 marks]

(c) Discuss the molecular orbital theory and use it to account for the ligand spectrochemical series. [11 marks]

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