

CHUKA



UNIVERSITY

**UNIVERSITY EXAMINATIONS  
RESIT/SPECIAL EXAMINATION**

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE  
CHEM 313: COORDINATION CHEMISTRY  
STREAMS: BSC TIME: 2 HOURS  
DAY/DATE: FRIDAY 13/08/2021 2.30 P.M – 4.30 P.M.**

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**INSTRUCTIONS**

- ANSWER ALL QUESTIONS

**QUESTION ONE (30 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]
- e) Write the systematic names of the following complexes. [5 marks]

- (i)  $(NH_4)_2 [Pt (NCS)_6]$
- (ii)  $[Ag (CH_3CH_2)_2] [Mn (H_2O)_2 (ox)_2]$
- iii)  $[Co (NH_3)_4Cl_2]$
- iv)  $[Pt (NH_3)_3Cl (C_2H_2) (NO_2)_3] (PO_4)_2$

(b) Discuss bonding and magnetism of  $[(NH_3)_6]^{2+}$  using the valence bond theory. [5 marks]

### QUESTION TWO (20 MARKS)

(a) 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. [4 marks]

(i) Hexaammine chromium(III) bromide

(ii) Potassium tetracyanonickelate (II)

(iii) Tetraamine chromium (III) -  $\mu$ - amido-  $\mu$ -hydroxobis (ethylenediammine) iron (III) sulphate.

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

### 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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