



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

University Examinations 2021/2022

**YEAR ONE SEMESTER ONE EXAMINATION FOR THE DEGREE OF MASTER OF
SCIENCE IN LEATHER TECHNOLOGY & MASTER OF SCIENCE IN CHEMISTRY**

**SLT 6117 ADVANCED COORDINATION CHEMISTRY/ SCH 6101 ADVANCED
TRANSITION METAL COMPLEXES**

Date: SEPTEMBER 2021

Time: 3 Hours.

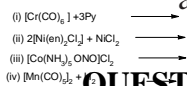
INSTRUCTIONS: Attempt all questions

QUESTION ONE (15 MARKS)

a) Using well labelled sketches differentiate between associative and dissociative reaction mechanisms [4 Marks]

b) Differentiate between Fisher and Shrock carbenes. [1 marks]

c) Name the species, draw the structures of, and give valence electron counts to the metal atoms in: (i) $\text{Fe}(\text{CO})_5$, (ii) $[\text{Fe}(\text{I})^5\text{-C}_5\text{H}_5](\text{CO})_2^-$. [6 Marks]



QUESTION TWO (15 MARKS)

a) Complete the following reactions [4 Marks]

b) Sketch the valence bond treatment (VBT) for the $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ion. Can VBT predict what the magnetism of this complex ion is? Sketch the CF *d*-orbital splitting diagram for $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$. Can CFT predict the magnetism of the complex? [4 Marks]

c) Which of the following complexes would you expect to suffer from a Jahn–Teller distortion: $[\text{CrI}_6]^{4-}$, $[\text{Cr}(\text{CN})_6]^{4-}$, $[\text{CoF}_6]^{3-}$ and $[\text{Mn}(\text{ox})_3]^{3-}$? Give reasons for your answers. [4 Marks]

d) Draw the structures for the corresponding names;

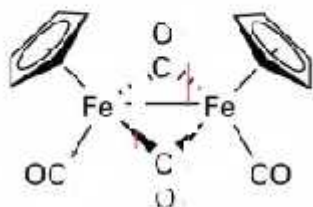
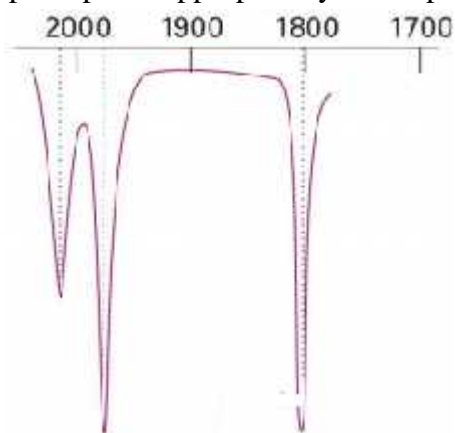
i) Bis(tetraaqua-u2-hydroxo iron(ii) chloride

i) dibromobis(ethylenediamine) cobalt(III) nitrate

iii) *cis*-bis(oxalato)dichlorochromium(III)

[3 Marks]

The diagram below shows an IR spectra of the compound drawn alongside. Assign the absorption peaks appropriately and explain your answer [4 Marks]



QUESTION THREE (15 MARKS)

a) Use the appropriate Tanabe–Sugano diagram to explain why $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ is essentially colorless in aqueous solution. What is the term symbol for the ground state of this complex cation? [6 Marks]

b) Sketch the MO diagram for the square planar $[\text{Cr}(\text{CO})_6]$ [6 Marks]

- c) The complex cation $[\text{Co}(\text{CO})_3(\text{PPh}_3)_2]^+$ has only a single $\nu(\text{CO})$ stretching frequency in the IR. Suggest a plausible structure for this compound. [3 Marks]

QUESTION FOUR (15 MARKS)

- a) What do you understand by π acceptor ligands? Give two examples [3 Marks]
- b) Which of the following obey the 18-electron rule? Show your working
i) $\text{Fe}(\text{CO})$ ii) $[\text{Rh}(\text{bipy})_2\text{Cl}]^+$? [2 Marks]
- c) Explain why an electronic transition for high-spin $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ is spin-forbidden, but for $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ is spin-allowed. [4 Marks]
- d) Discuss the important industrial applications of charge transfers (MLCT/LMCT) in Metal complexes [6 marks]

