



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

University Examinations 2021/2022

**YEAR ONE supplementary/special 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**

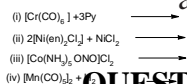
Date: April 2022

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) What is Schrock carbene [1 marks]
- c) Name the species, draw the structures of, and give valence electron counts to the metal atoms in: (i) $[\text{Ni}(\text{C}_2\text{O}_4)^{2-}]^{2-}$ (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 $[\text{Ni}(\text{NH}_3)_6]^{2+}$ ion. Can VBT predict what the magnetism of this complex ion is? Sketch the CF *d*-orbital splitting diagram for $[\text{Ni}(\text{NH}_3)_6]^{2+}$. 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]

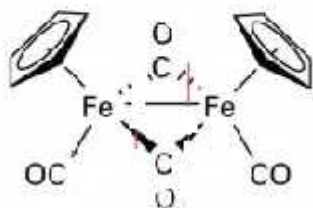
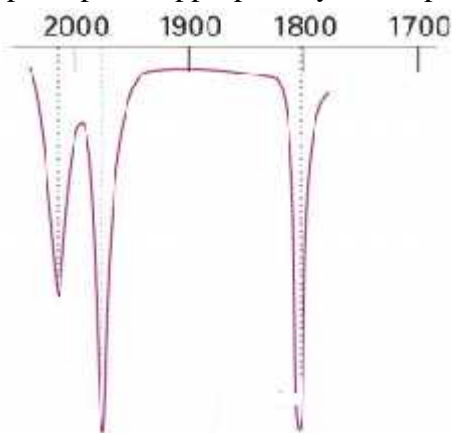
d) Draw the structures for the corresponding names;

- i. *cis*-bis(oxalato)dichlorochromium(III) ion
- ii. dibromobis(ethylenediamine) cobalt(III) nitrate
- iii. potassium diaminetetrachlorochromate(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 $[\text{Mn}(\text{NH}_3)_6]^{2+}$ 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 $[\text{Cr}(\text{CO})_6]$ [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 [2 Marks]
 - i) $\text{Fe}(\text{CO})$
 - ii) $[\text{Rh}(\text{bipy})_2\text{Cl}]^+$

- 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]

