

RAJARATA UNIVERSITY OF SRI LANKA FACULTY OF APPLIED SCIENCES

B.Sc. Honours in Chemistry Third Year - Semester I Examination – July / August 2023

CHE 3205 – ADVANCED INORGANIC CHEMISTRY I

Time: Two (02) hours

Answer all questions.

Use of a non-programmable calculator is permitted.

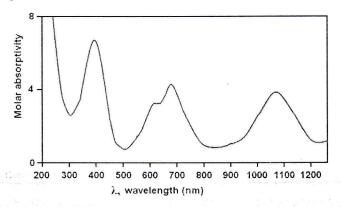
- a) KMnO₄ and MnSO₄ are two compounds containing the element manganese. Two compounds show two different colours, particularly the intensities. Explain the observation. Indicate their approximate molar absorptivity (ε).
 - b) With the use of ligand field theory, predict the d orbitals arrangement in the trigonal bipyramidal complex MX_5 in an energy level diagram. Include orbital diagram/s showing the x,y and z axes. Justify the order of arrangement. (30 marks)
- c) Relate spectroscopic properties intensity, absorption wavelength to photonic properties.

 Imagine how to obtain a higher energy EMR source with the same wavelength. Give one practical application utilizes that technique. (25 marks)
 - d) The transition metal complex MX₂Y₄ shows bond lengths as indicated below.
 - 2 (M-X) 2.02 Å
 - 2 (M-Y) 2.29 Å
 - 2 (M-Y) 2.97 Å

Obtain the energy level diagram for the d orbitals of the complex. Predict plausible electronic spectra for the complex. Justify your answer. (25 marks)

- a) Determine the term symbols for Boron atom at its most stable electronic configuration. Hint:
 Only open shell electrons needed to be considered. (14 marks)
 - b) Deduce the possible microstates for the complex [Ni(OH)₆]Cl₂ and identify the ground state.

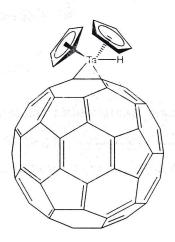
 Justify your selection of ground state. (24 marks)
 - c) The complex [Ni(OH)₆]Cl₂ gives the spectrum below. Assign the transitions for the peaks using an Orgel diagram.



(25 marks)

- d) Find the metal electron count and oxidation state of the central metal for each of the following compounds / ions.
 - i. $[Cp_2WH(C_2H_4)]^+$
 - ii. $[(\eta^5 C_5H_5)_2Co]^+$

iii.



(21 marks)

- e) All the transition metals (M) given are first row elements. Identify the metal in each case.
 - i. $[(\eta^5-C_5H_5)M(PMe_3)_2(Me)]I$ 18-electron species
 - ii. $[M(CO)_5]_2$ 18-electron species (assume M-M single bond) (16 marks)

- 3. a) Discuss the bonding in transition metal-carbonyls in detail. Use orbital diagrams in your explanations. (20 marks)
 - b) In metal complexes NO ligand shows two binding modes. Illustrate.

(20 marks)

c) With the UV irradiation, a Fisher carbene complex, (CO)₅W=CMe(OMe) was converted into a reactive intermediate with evolving a gas. The reactive intermediate immediately transferred into an 18e complex. The latter transition involved a shift of OMe group, and the newly formed complex was no longer a carbene. Predict the intermediate and the final product.

(30 marks)

d) Compare and contrast Fisher and Shrock carbene types.

(30 marks)

- 4. a) Determine the specified quantity in each of the following. Indicate assumptions if any.
 - i. The metal-metal bond order in $[(C_5H_5)Co(\mu-CO)]_2$
 - ii. The expected charge, z on [HRh(CO)(PPh₃)₃]^z

(20 marks)

b) Propose a mechanism for the reaction given below which is catalyzed by the transition metal complex, RhCl(PPh₃)₃.

$$CH_3CH=CH_2+H_2 \rightarrow CH_3CH_2CH_3$$

In the mechanism pathway, identifying followings in each step.

- i. Oxidation state
- ii. Coordination number
- iii. Number of valance electrons
- iv. Reaction type

(80 marks)

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