

BOWEN UNIVERSITY, IWO, OSUN STATE
COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
INDUSTRIAL CHEMISTRY PROGRAMME
2022/2023 B.SC DEGREE FIRST SEMESTER EXAMINATION

Course Code: CHM 431 **Course Title:** Structure and Coordination Chemistry **Credit:** 3
Date: /03/2022 **Time Allowed:** 3 hours

- INSTRUCTIONS:** (a) *Section A is Compulsory (30 marks)*
(b) Answer only ONE (1) question each in Sections A and B
(c) Each question carries 25 marks
(d) Answer each main question on a fresh page
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Section A

Question 1

- a. Bright was given a particular Fe(II) complex to prepare a new adduct. While working on his assignment, he realized his transition metal has oxidized to the Fe(III) state. Explain briefly what could be responsible for this as a chemistry student. **4 marks**
- b. Define the following terminology. Hence cite an appropriate example: **3 marks**
- i. Organometallic complex
- c. Draw the structure of propanone, identify the various possible electronic transitions as well as the estimated wavelength **6 marks**
- d. Answer the following questions using compounds $K_4[Fe(CN)_6]$ and $KAl(SO_4)_2$.
- i. Write a balanced equation for the ionization products of each of the compounds in an aqueous medium. **4 marks**
- ii. Identify two major differences between the two compounds. **3 marks**
- e. How do you describe valence bond theory? Hint: use Hydrogen molecule as an illustration. **5 marks**
- f. Briefly explain molecular orbital theory in accordance to the principle developed by Hund-Mulliken and Leonard-Jones in 1927 – 1929. **5 marks**

Section B

Question 2

- a. Using a simple diagrammatic illustration, explain the principle of back bonding. **5 marks**
- b. State the method of preparation for $Fe(CO)_5$ in the laboratory. Hence write the balanced equation for this reaction **5 marks**
- c. Name the following complexes and identify the type of isomerism they exhibit: **5 marks**
- i. $[PtBr(NH_3)_3]NO_2$
- ii. $[Pt(NO_2)(NH_3)_3]Br$
- c. State Beer Lambert Law and define all the terminologies used. **5 marks**

Question 3

Use the Figure given below to answer the following questions.

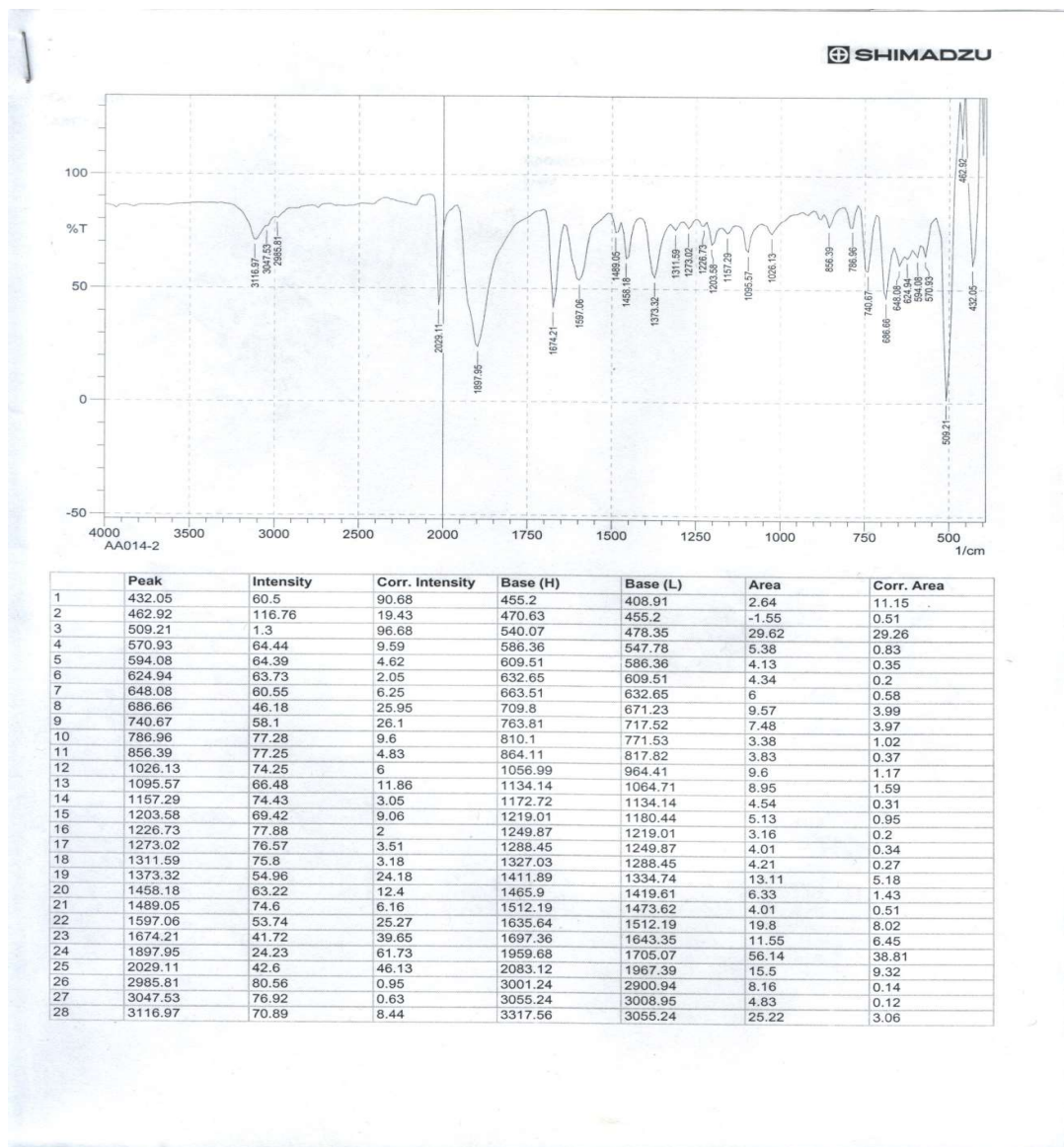


Figure 1: Spectrum of Compound A; $[\text{Re}(\text{C}_{14}\text{H}_{10}\text{N}_2\text{O})(\text{CO})_3\text{Br}]$

- a. Identify which type of spectrum is Figure 1 **2 marks**
- b. State any two types of spectroscopic techniques and what they are used to deduce during the elucidation of structures of new compounds. **4 marks**
- c.
 - i. What are metal carbonyls? **2 marks**
 - ii. State the properties of metal carbonyls. **5 marks**
- d. Use the complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ to answer the following questions:
 - i. Write the name and colour of this complex **2 marks**
 - ii. Write one common hydrate isomer of this complex **2 marks**
 - iii. Calculate its primary and secondary oxidation numbers **3 marks**

Section C
Question 4

- a. With the aid of appropriate scheme proposed for homonuclear diatomic molecule, determine molecular orbital, bond order and the type of bond involved for the followings;
i. N_2 **8 marks**
- b. According to Valence bond theory, highlight five (5) approaches of forming coordination complexes. **5 marks**
- c. Explain the nature of bonding in $[Ni(CN)_4]^{2-}$ on the basis of valence bond theory. **4 marks**
- d. Highlight three (3) factors affecting crystals field splitting. **3 marks**

Question 5

- a. Briefly explains the limitation of crystal field theory (CFT). **2 marks**
- b. With the aid of appropriate diagram, discuss the arrangement of ligand using square planar approach. **10 marks**
- c. Discuss the assumption of linear combination of atomic orbitals **4 marks**
- d. i. Energy of molecular orbital depends on how many factors. **1 mark**
ii. Highlight the factor(s) in question d. i. above **3 marks**

