



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY MAIN EXAMINATIONS**

**2021/2022 ACADEMIC YEAR**

**SECOND YEAR SECOND SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF**

**BACHELOR OF SCIENCE (CHEMISTRY), BACHELOR OF  
SCIENCE (INDUSTRIAL CHEMISTRY) AND BACHELOR OF  
EDUCATION (SCIENCE)**

**COURSE CODE: SCH 211**

**COURSE TITLE: COMPARATIVE CHEMISTRY OF D-BLOCK  
ELEMENTS**

**DATE: THURSDAY 21<sup>ST</sup> APRIL 2022**

**TIME: 12.00-2.00 PM**

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INSTRUCTIONS TO CANDIDATES

Total Marks: 70

Answer all the Questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

**Question One****(17 marks)**

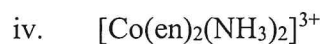
- a. Explain the following terms as used in the chemistry of d-block elements. Use examples where possible (6 Marks)
- Lanthanide contraction
  - Ambidentate ligands
  - Lewis acid and Lewis base
- b. Name the three main ores of Titanium (3 Marks)
- c. The octahedral complex  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  has a single d electron. To excite this electron from the ground state  $t_{2g}$  orbital to  $e_g$  orbital, this complex absorbs light from 450 nm to 600 nm. The maximum absorbance corresponding to  $\Delta_o$  occurs at 499 nm. Calculate the values of  $\Delta_o$  in Joules ( $c = 3.0 \times 10^8 \text{ m/s}$ ,  $h = 6.63 \times 10^{-34} \text{ J.s}$ ) (2 Marks)
- d. State and explain the TWO geometries that can be adopted by d-block complex with a coordination number of 4. Use of examples and/ illustrations is encouraged (6 Marks)

**Question Two****(20 Marks)**

- a. Calculate the magnetic moments,  $\mu_{\text{SL}}$  of  $\text{Cr}^{3+}$  ( $z=24$ ) in the absence of a crystal field (Lande splitting parameter, for a free electron, is 2.00023) (3 Marks)
- b. Explain why chromium ( $z=24$ ) has electronic configuration  $3d^54s^1$  and not  $3d^44s^2$  (3 Marks)
- c. Why do think transition metals possess high density and high melting and boiling points (3 Marks)
- d. Not all d-block elements are transition elements. Explain. Use of examples is encouraged (3 Marks)
- e. Describe how silver is extracted from its chief ore, Argentite (8 Marks)

**Question Three****(19 Marks)**

- a. Why is manganese ( $z=25$ ) more stable in the +2 state than in the +3 state and the reverse is true for iron ( $z=26$ )? (4 Marks)
- b. Explain why Zn ( $z=30$ ) does not exist in variable oxidation states (3 Marks)
- c. Give the systematic names of the following complexes (4 Marks)
- $[\text{Cr}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$
  - $\text{K}_4[\text{Fe}(\text{CN})_6]$
  - $[\text{Ag}(\text{NH}_3)_2][\text{Ag}(\text{CN})_2]$



d. Ziegler-Natta catalysts have evolved to four generations. Name the catalysts used each generation (4 Marks)

e. Outline any FOUR uses of copper (4 Marks)

**Question Four (14 Marks)**

a. Explain any THREE factors that determine the colour of a transition metal complex ion (6 Marks)

b.i. State the catalyst used in contact process (1 Mark)

ii. Briefly explain why a catalyst is required in this process (3 Marks)

c. State any FOUR properties of interstitial compounds (4 Marks)