

KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**FOURTH YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS**

FOR THE DEGREE OF BACHELOR OF CHEMISTRY

COURSE CODE: SCH 415


**COURSE TITLE: THE CHEMISTRY OF f-BLOCK ELEMENTS
DURATION: 2 HOURS**

DATE: 17/11/2022

TIME: 8:00AM-10:00AM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
 - Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 3 printed pages  Please Turn Over

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Question one (Compulsory) (30 Marks)

- (a) Explain the difference between d block elements and f block elements (4)
- (b) Justify the position of the lanthanides in the periodic table (2)
- (c) Describe ways in which the actinides resemble lanthanides (4)
- (d) State the consequences of the lanthanide contraction (4)
- (e) Account for the different oxidation states of actinides (2)
- (f) State four ligands that form complexes with lanthanide elements (4)
- (g) State and explain the trend of the following across the lanthanide series
 - (i) Basicity (3)
 - (ii) Malleability (3)
- (h) State any four properties of actinides (4)

Question Two (20 Marks)

- (a) Write an equation for calculating the effective electron voltage and define all the terms in the equation (2)
- (b) What is the implication of the equation to Aufbau order and the filling of f- orbital (2)
- (c) What is the significance of the equation to Rearserts hydrogenic order and the lanthanide contraction (2)
- (d) Calculate the spin only magnetic moment of
 - (i) La^{3+} (1)
 - (ii) Lu^{3+} (1)
 - (iii) Gd^{3+} (1)
- (e) Why is Zr similar to Hf (3)
- (f) What are inner transition elements? Explain their oxidation states, ability to form complexes and magnetic properties (6)
- (g) Explain why the magnetic and spectral properties of lanthanides differ from those of 3d and 4d block elements (3)

Question Three (20 Marks)

The processing of nuclear fuel and the separation of lighter actinide elements, U, Np, and Pu is an important industrial process. Discuss the chemistry involved in the various methods used to extract and separate these elements (20)

Question Four (20 Marks)

- (a) Explain the structure, preparation and bonding in ferrocene (6)
- (b) What is the 18 – electron rule (4)
- (c) Explain how molecular orbital theory explains the bonding and structure of metal carbonyls (6)

(d) State the magnetic property and hybridization of $\text{Ni}(\text{CO})_4$

(6)

Question Five (20 Marks)

- (a) What is a metallic bond? Explain the nature of the metallic bond based on free electron theory, valence bond theory and molecular orbital theory (10)
- (b) Give the structures of $\text{Ni}(\text{CO})_4$, $\text{Mn}(\text{CO})_{10}$, $\text{Fe}(\text{CO})_9$ and $\text{Co}(\text{CO})_8$ (4)
- (c) Explain why AuBr_2 complexes are dimeric but $\text{AuBr}(\text{CN})$ complexes are tetrameric (6)