



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF CHEMISTRY

COURSE CODE: SCH 412

COURSE TITLE: THE STUDY OF LANTHANIDES AND ACTINIDE
SERIES

DURATION: 2 HOURS

DATE: 11/1/22

TIME: 2-4 PM

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.

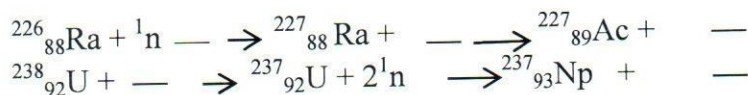
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Question 1 (Compulsory) 30 Marks

- (a) Comment on the stability of the various oxidation states of lanthanides (2)
- (b) What are the factors that make actinides to be exerting negative impacts on the environment? Discuss each of them. (8)
- (c) (i) What is responsible for nuclear criticality in actinides? (1)
(ii) What is the consequence of nuclear criticality (1)
(iii) State the factors that affect nuclear criticality (2)
- (d) State any four properties of actinides (4)
- (e) State any two uses of actinides (2)
- (a) Describe how the following techniques are applied to separate lanthanide
- (i) Fractional thermal decomposition of oxy salts (2)
- (ii) Paper Chromatography (2)
- (iii) Complex formation (2)
- (b) Use radiation particles to balance the following nuclear reactions (4)



Question 2 (20MKS)

- (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 mks]
- (b) Give the structures of $\text{Ni}(\text{CO})_4$, $\text{Mn}_2(\text{CO})_{10}$, $\text{Fe}_2(\text{CO})_9$ and $\text{Co}_2(\text{CO})_8$. [4mks]
- (c) Explain why AuBrR_2 complexes are dimeric but $\text{AuBr}(\text{CN})$ complexes are tetrameric. [6 mks]

Question 3 (20 Marks)

- (a) Explain the structure, preparation and bonding in ferrocene. [6mks]
- (b) What is 18 – electron rule? [2mks]
- (c) Explain how molecular orbital theory explains the bonding and structure of metal carbonyls. [6 mks]
- (d) State the magnetic property and hybridization of $\text{Ni}(\text{CO})_4$ [6 mks]

Question 4 (20Marks)

- (a) Metal – Ligand multiple bonding is a feature of the heavy metals. Give examples of the types of ligand and the characteristics of the metals involved (6)
- (b) Why are the oxo ligands ‘cis’ in the Molybdenum complex $\text{MoO}_2(\text{Ph}_3\text{PO})_2\text{Cl}_2$ but ‘trans’ for the uranium complex $\text{UO}_2(\text{Ph}_3\text{PO})_2\text{Cl}_2$? Explain why U-O bond lengths are about the same length as the Mo-O bond lengths (8)

- (c) Explain why AuBrR_2 complexes are dimeric but $\text{AuBr}_2(\text{CN})$ complexes are tetrameric
(6)

Question 5 (20 Marks)

- (a) Using atleast four examples, discuss the extent to which the lanthanides are chemically similar to s block elements (4)
- (b) (i) What is responsible for the colour of lanthanides? (1)
(ii) What are the features of lanthanides that are colourless (1)
(iii) Give examples of lanthanides colours and compare the colour with the properties that provide the colour (2)
- (c) Write the electronic configurations of the following ions (3)
(i) Ce^{3+}
(ii) Am^{3+}
(iii) Hence determine which series they belong to.
- (d) Highlight four similarities between lanthanides and actinides (4)
- (e) Justify the position of Scandium and Lanthanides in the periodic table (2)
- (f) State two similarities between Scandium and Lanthanides in the periodic table (4)
- (g) Many lanthanide compounds are paramagnetic. Explain why only those of Gd^{3+} have magnetic moments that are predicted by the spin only formula (3)