NATIONAL OPEN UNIVERSITY OF NIGERIA
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESS WAY, JABI - ABUJA.
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2024_2 EXAMINATION

COURSE CODE: **CHM 426**
COURSE TITLE: **CHEMISTRY OF LANTHANIDES AND ACTINIDES**
COURSE UNIT: **2**
TIME: **2 HOURS**
INSTRUCTION: **ANSWER QUESTION NO. ONE (1) AND ANY OTHER TWO (2) QUESTIONS.**

QUESTION ONE

1(a)(i) Highlight five (5) general physical properties of Actinoids series (5 marks)

(ii)Which is the most common oxidation state of the lanthanides and how is it formed? What is its configuration? (5 marks)

(b)(i) What is responsible for the nuclear criticality in actinides? (2 marks)

(ii) What is the consequence of nuclear criticality? (2 marks)

(iii) State any four (4) factors that affect nuclear criticality (4 marks)

(c)Give one example each of ore of lanthanide which:

(i) contains mostly the lighter lanthanides (1 mark)

(ii) contains mostly the heavier lanthanides (1 mark)

(iii) contains a fairly even distribution of the lanthanides (1 mark)

(d) Which of the Lanthanide elements

(i) has the smallest atomic radius (1 mark)
(ii) is used in MRI technology (1 mark)
(iii)Has the lowest melting point (1 mark)
(iv) is radioactive (1 mark)
(v) is the only tetrapositive ion stable in aqueous solution that absorbs in the blue and ultraviolet regions. (1 mark)

(e) Explain why Actinide contraction is greater from element to element than lanthanide contraction (4 marks)

TOTAL MARK QUESTION 1 = 30 MARKS

QUESTION TWO

2(a)Write down the chemical equations for the reactions of Cerium with

(i) water (2 marks)
(ii) acids, (2 marks)
(iii) oxygen (2 marks)
(iv) halogens (2 marks)

(b)Why is the separation of the lanthanides a difficult task? List three important methods used for the separation of lanthanide metals. (6 marks)

(c)(i)Which of the element has a greater atomic radius: Gd or Tb and why (3 marks)

(ii) What do the lanthanides have in common with the noble gases? (2 marks)

(iii) How do succeeding lanthanides differ from its immediate predecessor? (1 mark)

TOTAL MARK QUESTION 2 = 20 MARKS

QUESTION THREE

3 (a) Highlight any four (4) properties of uranocene (4 marks)

(b) Use chemical equations to illustrate what happens when

(i) actinium (III) hydroxide reacts with hydrofluoric acid (3 marks)

(ii) Uranyl sulphate is treated with an excess of Na_2CO_3 (3 marks)

(iii) Ammonium diurinate is calcinated (3 marks)

(c)(i) Comment on the occurrence and distribution of uranium (4 marks)

(ii) What do you understand by Pyrophoricity of actinides? (3 marks)

TOTAL MARK QUESTION 3 = 20 MARKS

QUESTION FOUR

4(a)(i) Explain why the 4f orbitals in the Ln^{3+} ion do not participate directly in bonding (2 marks)

(ii) Highlight how Pm can be obtained from its ore (2 marks)

(iii) Explain why the inner transition metal ions with zero or completely f – f-filled orbital are colourless (4 marks)

(b) Give three (3) reasons why the organometallic compounds of the lanthanides are dominated by good donor ligands, with complexes of acceptor ligands being rare (9 marks)

(c) Write the chemical formula of the oxides formed by the following actinide elements

(i) Pu (1 mark)

(ii) Th (1 mark)

(iii) Pa (1 mark)

TOTAL MARK QUESTION 4 = 20 MARKS

QUESTION FIVE

5(a)(i) Arrange the following ions in the order of increasing basicity: La^{3+}; Lu^{3+}; Nd^{3+} and Er^{3+}? (4 marks)

(ii) Comment on the coordination number of lanthanides and provide evidence for the existent of the coordination number of 9. (10 marks)

(b) What are the coordination numbers and shapes of the following complexes?

(i) $[Er(NCS)_6]$ (3 marks)

(ii) $[Lu(2,6\text{-dimethylphenyl})_4]^-$ (3 marks)

TOTAL MARK QUESTION 5 = 20 MARKS