



NATIONAL OPEN UNIVERSITY OF NIGERIA  
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE  
EXPRESS WAY, JABI - ABUJA.  
FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY  
2024 1 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 any four (4) differences between Scandium and the Lanthanoids (4 marks)  
(ii) Highlight the nuclear applications -of lanthanides (5 marks)
- (b)(i) List any five (5) oxyhalides of actinides (5 marks)  
(ii) State with reason the difference between Actinium and the other Actinides in terms of oxidation state (4 marks)
- (c)(i) State any four (4) properties of actinides that make them hazardous to the environment (4 marks)  
(ii) Explain the factor that accounts for similar ionic radii for  $Nb^{5+}$  /  $Ta^{5+}$ . (4 marks)
- (d) Arrange the following lanthanides in the stability order of +2 oxidation state:  
Yb, Eu, Tm and Sm. (4 marks)

**TOTAL MARK QUESTION 1 = 30 MARKS**

**QUESTION TWO**

- 2(a) State the Oddo-Harkins rule? Hence, compare the abundance of  ${}_{60}Nd$  and  ${}_{61}Pm$  in the ore of lanthanides (6 marks)
- (b) Compare Lanthanides and Actinides in terms of:
- (i) Ligand-metal interaction (2 marks)
  - (ii) Magnetic properties (3 marks)
  - (iii) Coordination chemistry (2 marks)
  - (iv) Valence shell configuration (2 marks)
  - (v) Characteristic oxidation state (3 marks)
- (c) Highlight the application of lanthanides for Ceramic purposes (2 marks)

**TOTAL MARK QUESTION 2 = 20 MARKS**

**QUESTION THREE**

- 3 (a)(i) Mention three (3) particles readily emitted by Depleted uranium (3 marks)  
(ii) How can any two of the particles in (3ai) above be blocked for safety (4 marks)
- (b) Highlight any four (4) properties of Uranocene (4 marks)
- (c)(i) List three (3) main oxides of uranium and their colour (6 marks)
- (d) Give the formula of the product formed in the following reactions
- (i) The addition of  $\text{H}_2\text{O}_2$  to a solution of uranium oxide at pH 2.5 – 3.5 (1 mark)
- (ii) Protactinium fluoride reacting with air (1 mark)
- (iii) Reaction of Uranium (III) oxide and Hydrofluoric acid. (1 mark)

**TOTAL MARK QUESTION 3 = 20 MARKS**

**QUESTION FOUR**

- 4(a)(i) Explain why Mendeleevian period table accommodated only one element in lanthanide series. (3 marks)
- (ii) What application of lanthanide is traceable to the luminescence properties of their lanthanoid complexes (2 marks)
- (b) What is the name given the following?
- (i) Vertical arrangement in the periodic table (1 mark)
- (ii) Horizontal arrangement in the periodic table (1 mark)
- (iii) A whole class of elements having their valence electrons in the same orbitals (1 mark)
- (c)(i) Explain why the elements beyond atomic number 102 are unstable (5 marks)
- (ii) The chemistry of the actinoid elements is not as smooth as that of the lanthanoids. Justify this statement by giving some examples from the oxidation state of these elements (7 marks)

**TOTAL MARK QUESTION 4 = 20 MARKS**

**QUESTION FIVE**

- 5 (a) Highlight two views regarding the electronic configuration of actinides (5 marks)
- (b) List the three (3) main hydrolyzed species formed from the hydrolysis of aqueous solutions of uranium salts at room temperature. Which of the species listed is the most stable at higher temperature (5 marks)
- (c) Provide the products of the following reactions