



National Open University of Nigeria
Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi - Abuja
Faculty of Science
APRIL/MAY, 2019 EXAMINATIONS

COURSE CODE: CHM426

COURSE TITLE: Chemistry of lanthanides and actinides

CREDIT: 2 Units

TIME ALLOWED: 2 Hours

INSTRUCTION: Answer Question ONE (1) and any other Three (3) Questions

Question 1

- Q1. a) Highlight three general physical properties of Lanthanide series (3 marks)
- b) In ion exchange processing, why is the order of elution: $\text{Lu} \rightarrow \text{La}$? (3 marks)
- c) The haphazardly recorded ionic radii of M^{3+} state of $_{57}\text{La}$, $_{58}\text{Ce}$ and $_{59}\text{Pr}$ are 1.03, 1.06 and 1.01, reassign each value correctly for each ion (3 marks)
- d) If the number of unpaired electrons in the hydrated salts of Ce^{3+} and Pr^{3+} are x and y respectively, what will be the value of $x + y$? (3 marks)
- e) Account for why the separation of the lanthanides is so difficult? (3 marks)
- f) Give one example each of an ore of lanthanide which:
- (i) contains mostly the lighter lanthanides (2 marks)
 - (ii) contains mostly the heavier lanthanides (2 marks)
 - (iii) contains a fairly even distribution of the lanthanides (2 marks)
- g) Describe formation of depleted uranium (DU) and its one major use (4 marks)

Total mark Question 1 = 25 marks

Question 2

- Q2 a) Explain why the salts of La^{3+} , Ce^{3+} and Lu^{3+} appear colorless (3 marks)
- b) Write an equation for effective electron voltage and define each term (3 marks)
- c) Distinguish between Aufbau order and Reasserts hydrogenic order (3 marks)
- d) Write out expected equilibrium reaction forms when a solution containing the La^{3+} cations is passed down the column of ion exchange process (3 marks)

- e) List two complexing ligands that are valuable in equation (4d) above (3 marks)

Total mark Question 2 = 15 marks

Question 3

- Q3 a) Comment on the coordination number of lanthanides and provide evidence for the existence of the coordination number of 9. (3 marks)
- b) Arrange La^{3+} , Ce^{3+} , Pr^{3+} , Nd^{3+} and Pm^{3+} in increasing order of basicity (3 marks)
- c) Mendeleevian period table accommodated only one element in lanthanide series. Why? (3 marks)
- d) Itemize three general properties of Actinide series (6 marks)

Total mark Question 3 = 15 marks

Question 4

- a) Why are transition metal ions with zero, partially and completely filled orbital colourless? (3 marks)
- b) What factor accounts for similar ionic radii for Zr^{4+} / Hf^{4+} and Nb^{5+} / Ta^{5+} . Hence, explain it briefly (3 marks)
- c) Write suitable equations to show the reaction of lanthanide
- (i) with cold water (3 marks)
- (ii) with hot water (3 marks)
- d) Use equation to explain the dissolution reaction of $\text{Lu}(\text{OH})_3$ in NaOH . (3 marks)

Total mark Question 4 = 15 marks

Question 5

- Q5 a) Which of the two types of hydrides of Ln is more conducting? Give reason for your answer (3 marks)
- b) Write formula for two typical examples of double salt of lanthanide ion (3 marks)
- c) What are the coordination numbers and shapes of the following complexes?
- (i) $[\text{Lu}(\text{2,6-dimethylphenyl})]^-$ (3 marks)
- (ii) $[\text{Ce}^{\text{IV}}\text{Cl}_6]^{2-}$ (3 marks)
- d) What application of lanthanide is traceable to the luminescence properties of their lanthanoid complexes (3 marks)

Total mark Question 5 = 15 marks