

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA  
DEPARTMENT OF CHEMISTRY

FIRST SEMESTER EXAMINATION 2022/2023 ACADEMIC SESSION

COURSE CODE: CHM412

COURSE UNIT: 2

COURSE TITLE: RADIATION AND NUCLEAR CHEMISTRY

INSTRUCTION: ANSWER ANY THREE QUESTIONS

TIME: 2 HOURS

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- Q1(a) i) Explain what makes an isotope radioactive.  
ii) Why do radioactive isotopes undergo radioactive decay?  
iii) How does the energy released by nuclear reactions compare to that released by ordinary chemical reactions?
- (b) In each of the following pairs, one of the nuclides is radioactive and the other is stable and nonradioactive. Determine which is radioactive and which is stable, and explain your choice briefly.
- i) Y-90 or Zr-90  
ii) Cr-52 or Cr-49
- (c) Why is nuclear fission considered a "chain reaction"?

- Q2a) What do you understand by potential well?
- b) Enumerate any five rules that are valid in the potential well for a single particle shell model.
- c) Briefly explain three possible types of excitation for  $^{238}\text{U}$  through interaction with high energy heavy ion:

- Q3a) Draw a block diagram illustrating the fate of hazardous contaminants in an ecosystem
- b) Describe briefly the:
- i. Three basic principles for keeping radiations exposure to a minimum level  
ii. Three stages of protection from radiation in larger organizations,  
iii. Two control checks after radiation protection from radiochemical laboratory
- c) Write short note on the use of Geiger-Muller Counter for detection and measuring ionizing radiation

- Q4a) Describe the following modes of radioactive decay processes:
- i. Beta-plus decay  
ii. Electron capture
- b) Compare and contrast electron capture and positron emission.
- c) What nuclear process or processes lead to each of the results listed below?
- i. The number of neutrons increases by 1.  
ii. Atomic number decreases by 2.  
iii. The number of neutrons decreases by 2.  
iv. Atomic number decreases by 1.  
v. The number of protons increases by 1.  
vi. No change in the number of protons and neutrons.