



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

SEPTEMBER, 2020_1 EXAMINATIONS

COURSE CODE: PHY 402
COURSE TITLE: NUCLEAR PHYSICS
CREDIT UNIT: 3
TIME ALLOWED: (2½ HRS)

INSTRUCTION: Answer question 1 and any other four questions

Constant values:

$M_n = 1.009$ $M_H = 1.007825$ $1 \text{ amu} = 931 \text{ MeV}$

$^{98}_{42}\text{Mo} := 97.907$ $^{16}_8\text{O} := 15.994920$ $^{235}_{92}\text{U} := 235.004$ $^{136}_{54}\text{Xe} := 135.917$

$M_n = 1.00898 \text{ u}$, $M_p = 1.000759 \text{ u}$ ^4_2He nucleus mass = 4.00277. $1 \text{ u} = 931 \text{ MeV}$

$^{16}_8\text{O} = 15.994915 \text{ u}$, $^{17}_8\text{O} = 16.999133 \text{ u}$

QUESTION 1

- a. What is nuclide? (2 marks)
- b. What do you understand by the following terms?
- i). Packing fraction (3marks)
- ii). Isotones (2 marks)
- iii). Excess mass (3 marks)
- iv). Isomers (2 marks)
- v). Isobars (2 marks)
- c. State the relationship between the radius of nucleus (r) and the number particle (A) (2 marks)
- d. Differentiate between excess mass and packing fraction (6 marks)

QUESTION 2

- a. What is mass defect? (3 marks)
- b. What do you understand by the terms Nuclear Binding energy and Separation energy? (3 marks)
- c. Calculate the separation energy of neutron $^{17}_8\text{O}$. Make a brief comment from the result above.
- $^{16}_8\text{O} = 15.994915\text{U}$, $^{17}_8\text{O} = 16.999133$ $M_n = 1.00898\text{U}$ (6 marks)

QUESTION 3

- a. List three ways by which γ - rays can dislodge electrons from both inner and outer orbits. (4.5 marks)
- b. What is radioactivity decay? (3 marks)
- c. List three radioactive series (4.5 marks)

QUESTION 4

- a. Define the following terms:
- i. Activity (3 marks)
- ii. Half-life (3 marks)
- b. Show that Half-life $T_{1/2} = \frac{0.693}{\lambda}$ (6 marks)

QUESTION 5

- a. What is the nuclear radius of ^{40}Ca ? (3 marks)
- b. What is the ratio of the radii of ^{238}U and ^4He Make brief comment on your answer. (5 marks)
- c. Show that ^8Be is unstable with respect to decay into two alpha particles. (4 marks)

QUESTION 6

- a. Calculate in MeV the energy liberated when helium nucleus $^4_{\text{He}}$ is produced by fusing two neutrons and two protons ($M_n = 1.00898\text{U}$, $M_p = 1.000759\text{U}$ ^4_2He nucleus mass= 4.00277. $1\text{U} = 931\text{MeV}$) (5 marks)
- b. What do you understand by nuclear reaction? (3 marks)
- c. What is the difference between nuclear fission reaction and nuclear fusion reaction? (4 marks)