



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

DEPARTMENT OF PURE AND APPLIED SCIENCE

2021_1 EXAMINATIONS

COURSE CODE: PHY402
COURSE TITLE: NUCLEAR PHYSICS
CREDIT UNIT: 3
TIME ALLOWED: (2½ HRS)

INSTRUCTION: *Answer question 1 and any other four questions*

CONSTANTS: Avogadro's number = 6.02×10^{23} atoms/g-mole; $c=3 \times 10^8$ m/s; $m_e=9.109 \times 10^{-31}$ kg (0.00054858u); $m_p=1.673 \times 10^{-27}$ kg (1.007825u); $m_n=1.675 \times 10^{-27}$ kg (1.008665u); $1\text{\AA}=10^{-10}$ m; $1\text{fm}=10^{-15}$ m; $1\text{eV}=1.602 \times 10^{-19}$ J; $1\text{u}=1.661 \times 10^{-27}$ kg; $R_0=1.3 \times 10^{-15}$ m (1.3fm)

QUESTION ONE

- A. Define and make clear distinctions between the terms (i) neutron, (ii) nucleon, (iii) nucleus, (iv) nuclide **(8 marks)**
- B. (i) State the three radioactive series **(6 marks)**
(ii) Discuss the major difference between Gamma ray and X – ray **(4 marks)**
- C. What are the health effects of exposure to gamma radiation? **(4 marks)**

QUESTION TWO

- A. Explain elastic and inelastic collisions as related to neutrons **(4 marks)**
- B. What is meant by the range of an α -particle? **(2 marks)**
- C. List 3 properties of nuclear force **(6 marks)**

QUESTION THREE

- A. Briefly discuss how the initial activity rate of a radioactive substance is related to its half-life? **(4 marks)**
- B. Calculate the age of the Shroud of Turin given that the amount of ^{14}C found in it, is 92% of that in living tissue. Given that N_A is $6.02 \times 10^{23} \text{ mol}^{-1}$. **(4 marks)**
- C. Calculate the activity due to ^{14}C in 1.00 kg of carbon found in a living organism. Express the activity in units of Bq and Ci. . **(4 marks)**

QUESTION FOUR

- A. Briefly explain Compton Effect. **(4 marks)**
- B. Mention three projectiles for artificial transmutation **(3 marks)**
- C. What are the types of nuclear reaction that can occur? **(5 marks)**

QUESTION FIVE

- A Differentiate between nuclear fusion and nuclear fission. **(8 marks)**
- B. What is the physical significance of Q-value? **(4 marks)**

QUESTION SIX

- A. Explain the term nuclear force **(4 marks)**
- B The weak nuclear force is responsible for radioactive beta decay. One of the carriers of the weak nuclear force is the Z boson with a mass of 92 GeV (where mass is given in energy units and Planck's constant is $h=4.135 \times 10^{-15} \text{ eV}\cdot\text{s}$)
- i) If the boson is a virtual particle, what is the maximum time it can exist before decaying? **(4 marks)**
- ii) If the boson is traveling about the speed of light, how far can it travel in that time? (The nucleus is about 10^{-15} m in diameter.) **(4 marks)**