NATIONAL OPEN UNIVERSITY OF NIGERIA
14/16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
JUNE/JULY EXAMINATION

COURSE CODE: PHY402
COURSE TITLE: Nuclear Physics (3 units)
TIME ALLOWED: 3 Hours
INSTRUCTION: Answer any five questions

PHYSICAL CONSTANTS:
Speed of light $c = 2.9979\ ms^{-1}$; mass of electro $m_e = 0.9110 \times 10^{-31} kg$;
Electronic charge $e = 1.6022 \times 10^{-19} C$; Avogadro's number
$N_A = 6.0221 \times 10^{26} kmol^{-1}$; Boltzmann constant
$k = 1.3806 \times 10^{-23} JK^{-1}$; Plank's constant $h = 6.6257 \times 10^{-34} Js$;
$\mu_0 = 4\pi \times 10^{-7} Henry/m$.

1. (a) Define the terms (i) excess mass (ii) parking fraction
4 marks
(b) With reference to nuclear size, show that the electron is NOT a constituent of the nucleus

10 marks
2. (a)(i) Distinguish between **isotones** and **isobars**
4 marks
(ii) What are **isomers**?
1 mark
(b) A nucleus with mass number A = 235 splits into two nuclei whose mass numbers are in the ratio of 2:1. Find the radii of the nuclei.
9 marks

3. (a) List **FOUR** models of the nucleus
4 marks
(b) (i) Write down the Weizacker's semi-empirical formula nuclear binding energy formula and explain each of the terms
4 marks
(ii) Using Weizacker's semi-empirical formula the atomic number of the most stable nucleus for a given odd mass number A.
6 marks

4.(a) Define the terms *nuclear binding energy* and *separation energy*.
6 marks

(c) Calculate the binding energy of $^{126}_{52}Te$.

You may use the following data: Rest masses of proton is $1.67252 \times 10^{-27} kg$ or $1.007277\ u$, neutron is $1.67482 \times 10^{-27} kg$ or $1.008665\ u$.

8 marks

5. (a) Obtain a formula for calculating the *half-life* of a radioactive substance.
of a radioactive substance
8 marks
(b) Define the mean-life of a radioactive element show that the mean life $\bar{T} = \frac{1}{\lambda}$ where λ is the decay constant.

6 marks

6 (a) What is meant by the range of an α-particle?
7 marks
(b) Explain the processes involved in a γ decay scheme of a nuclide.
7 marks

7. (a) What do you understand by the term "specific ionization"? Write the equation relating the specific ionization and the velocity of heavy particles. **8 marks**
(b) Describe one of the ways by which energy is lost when an electron interact with matter.

6 marks