



NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, NnamdiAzikiwe Expressway, Plot 91, Cadastral Zone, Jabi, Abuja
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

JANUARY 2018 EXAMINATION QUESTIONS

COURSE CODE: PHY402

TIME: 3 HOURS

COURSE TITLE: NUCLEAR PHYSICS

COURSE UNIT: 3 units

ANSWER ANY FIVE QUESTIONS

1. a) Using the $\gamma\alpha A^{1/3}$ observation, estimate the average density of a nucleus, (7 MARKS)
b) With the result of (1), estimate the rest energy of 1\AA^3 of nuclear matter. (7 MARKS)
2. a) Calculate the binding energy per nucleon of ${}^7\text{Li}$. (8 MARKS)
b) Calculate the mass defect of ${}^{238}\text{U}$ (6 MARKS)
3. a) Calculate the minimum photon energy necessary to dissociate the deuteron i.e. $\gamma + d \rightarrow p + n$. Take the deuteron binding energy to be 2.224589 MeV
b) The maximum kinetic energy of the positron spectrum emitted in the decay ${}^{11}\text{C} \rightarrow {}^{11}\text{B}$ is 1.983 ± 0.003 MeV. Use this information and the known mass of ${}^{11}\text{B}$ to calculate the mass of ${}^{11}\text{C}$.
4. A by-product of some fission reactor is ${}^{239}\text{Pu}$ which is an α -emitter with a half life of 24,120 yrs.
Consider 1kg of ${}^{239}\text{Pu}$ nuclei at $t = 0$.
(a) What is the number of ${}^{239}\text{Pu}$ nuclei at $t = 0$?
(b) What is the initial activity?
(c) How long would you need to store the plutonium until it had decayed to a safe activity level of 0.1 Bq?
5. On the basis of Q values determine if the ${}^{98}\text{TC}$ nucleus can decay by
(a) β^- decay (4 marks)
(b) β^+ decay (5 marks)
(c) electron capture (5 marks)
6. a) What do you understand by the following:
(i) fast diffusion length (2.5 marks)
(ii) Cerenkov radiations (2.5 marks)
(iii) moderation (2 marks)
b) Explain the following :
(i) average log energy decrement (2 marks)
(ii) pair production (2.5 marks)
(iii) Compton edge energy (2.5 marks)