



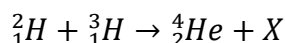
NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS
2025_2 EXAMINATIONS

COURSE CODE: PHY 456
COURSE TITLE: NUCLEAR REACTOR PHYSICS
CREDIT UNIT: 3
TIME ALLOWED: 3 HRS
INSTRUCTION: Answer question 1 and any other three questions

CONSTANTS (Planck's constant divide by 2π) = 1.055×10^{-34} Js
= 9.0×10^9 N.m²/C²
Electron charge (e) = 1.6×10^{-19} C
Electron mass = 9.1×10^{-31} kg
Mass of Hydrogen = 1.007825 u
Mass of neutron = 1.008665 u
Boltzmann constant (k_B) = 1.381×10^{-23} J/K
Avogadro's Number (N_A) = 6.022×10^{23} atoms/mole
1 eV = 1.6×10^{-19} J
1 u = 1.66×10^{-27} kg

QUESTION 1

- A. List five ways in which neutrons can interact with nuclei. (5 marks)
- B. What is a moderator? (2 marks)
- C. What is a nuclear reactor? (2 marks)
- D. What is meant by the following terms: nuclear power, nuclear energy and atomic energy? (7.5 marks)
- E. Consider the following nuclear fusion reaction that uses deuterium and tritium as fuel.



- (i). Complete the reaction equation. What is the name of the new particle released during the reaction? (2.5 mark)

- (ii). Determine the mass defect of a single reaction, given the following information.

${}^2_1\text{H} = 2.0141 \text{ amu}$, ${}^3_1\text{H} = 3.016049 \text{ amu}$, ${}^4_2\text{H} = 4.0026 \text{ amu}$, ${}_0^1\text{n} = 1.0087 \text{ amu}$ (3 marks)

- (iii). Determine the energy in joules released during a single fusion reaction. (3 marks)

QUESTION 2

A. What is a Cross Section in nuclear physics? (3 marks)

B. Show that macroscopic collision density F is given by (12 marks)

QUESTION 3

A. Define neutron moderation, hence list two examples of good moderators. (4.5 marks)

B. With the aid of a suitable diagram, explain two frames of reference considered for neutron thermalization. (6 marks)

C. List any 3 parts of a nuclear reactor? (4.5 marks)

QUESTION 4

A. List two types of frames of references considered for neutron moderation. (5 marks)

B. Show that fractional energy, $\frac{E_1}{E_0} = \frac{[1+A^2+2ACos\theta]}{[1+A]^2}$ (10 marks)

QUESTION 5

A. What is meant by a reactor poison? (2 marks)

B. Calculate the power density of a typical PWR reactor such as Koeberg Unit 1 (4 marks)

C. Explain how the temperature coefficient of reactivity is largely determined by the resonances in ^{238}U . (3 marks)

D. List the main component in nuclear reactor (6 marks)

QUESTION 6

A. List and discuss any four component of Nuclear Reactor (8 marks)

B. Enumerate and discuss any three type of Nuclear reactor (4.5 marks)

C. What is the medium utilization factor? (2.5 marks)