EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE – 2010/2011

FIRST SEMESTER (August /September - 2016)

PH 303 - NUCLEAR PHYSICS (Special Repeat)

e: 01 hour.

ver ALL Questions

Define the term *Chain disintegration* of a radioactive substance.

Consider the chain disintegration $A \rightarrow B \rightarrow C$ (stable). The decay constants of A and B are λ_A and λ_B ($\gg \lambda_A$) respectively. Under the initial condition, the number of atoms of B is zero.

Derive an expression for the number of atoms in the second element to be formed of the form $N_B = \frac{\lambda_A N_{OA}}{(\lambda_B - \lambda_A)} [exp(-\lambda_A t) - exp(-\lambda_B t)]$, where N_{OA} is the number of atoms of parent nuclide present initially.

If the daughter is short lived than parent, then show that for large times, the ratio of the elements of the parent and daughter becomes constant and has the value

$$\frac{N_B}{N_A} = \frac{\lambda_A}{\lambda_B} [1 - exp(-\lambda_B t)]$$

Explain the decay process for $\lambda_B \gg \lambda_A$ and $\lambda_A \gg \lambda_B$ with suitable graphs.

2. Define the term *scattering process* and hence distinguish *elastic scatteri* from *inelastic scattering process* of a nuclear reaction.

(a) For a reaction of the type $X(a, b)Y$ show that:

$$Q = \left(\frac{m_a}{m_y} - 1\right)T_a + \left(\frac{m_b}{m_y} + 1\right)T_b - \frac{2}{m_y}\sqrt{(m_a m_b T_a T_b)}\cos\theta$$

where the symbols have their usual meanings and θ is the angle of particle direction of incidence. Hence, deduce the expression for maximum Q value

(b) ${}^{4}_{2}He$ particles of kinetic energy 7.0 MeV interact with ${}^{14}_{7}N$ and produce ${}^{1}_{1}$ of kinetic energy 2.0 MeV and ${}^{17}_{8}O$. Calculate the kinetic energy differe reaction when it has the maximum value.

You may use the following information useful :

${}^{1}_{1}H$= 1.00794 amu, ${}^{4}_{2}He$= 4.00260 amu, ${}^{17}_{8}O$= 16.99913 amu, ${}^{14}_{7}N$= 14.00670