EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2001/2002

(APRIL 2002)

PH 303 NUCLEAR PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. Define scattering process and elastic scattering. 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 b with the direction of incidence.
Determine the Q value of the reaction $N^{14}(\alpha,p)O^{17}$ if the kinetic energy of the incoming alpha particle is 4.0 MeV and the proton moving at an angle 60^0 to the direction of motion of the alpha particle and having a kinetic energy 2.09 MeV.
You may assume the following values.

(i) mass of the α particle $(m_\alpha) = 4.002604 \ \ a.m.u$

(ii) mass of the proton $(m_p) = 1.007825 \ \ a.m.u$

(iii) mass of the oxygen $(m_O) = 15.990523 \ \ a.m.u$

(iv) $1a.m.u = 931.3MeV$

2. Define the decay constant λ, half-life $T_{\frac{1}{2}}$, mean-life $\bar{T}$ and the activity of a radioactive element. Establish the relationships

$$\lambda^{-1} = T_{\frac{1}{2}}(ln2)^{-1} = \bar{T}$$

A radio-nuclide A_1 with decay constant λ_1 transforms into a radio-nuclide A_2 with decay constant λ_2. Assuming that at the initial stage the sample contained only the radio nuclide A_1;

(i) Find the equation describing accumulation of the radio-nuclide A_2 with time.

(ii) Show that the time interval after which the activity of radio-nuclide A_2 reaches the maximum value is

$$t_{max} = \frac{ln\frac{\lambda_1}{\lambda_2}}{\lambda_1 - \lambda_2}$$