EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2003/2004

(NOV/DEC 2004)

FIRST SEMESTER

PH 303 NUCLEAR PHYSICS

Time: 01 hour.

Answer ALL Questions

[1] Explain what is meant by chain disintegration.
A freshly prepared radioisotope A decays via a daughter nucleus B into a stable element C.
Derive an expression for the number of daughter atoms N_B present at any later time t in terms of the original number N_{0A} of the parent atoms and the decay constants λ_A, λ_B of the parent and daughter nuclei.
If at time $t = 0$, the number of atoms of B is zero, show that at $t = t_0$, it would be maximum, where $t_0 = \dfrac{\ln(\lambda_A / \lambda_B)}{\lambda_A - \lambda_B}$

Consider the decay scheme

$$RaE \xrightarrow{\beta} RaF \xrightarrow{\beta} RaG \text{ (stable)}$$

A freshly purified sample of *RaE* weighs 2.00×10^{-10}gm at time t = 0. If the sample is not disturbed, calculate the time at which the greatest number of atoms of *RaF* will present and find this number
Half-life of *RaE* = 5 days, Half-life of *RaF* = 138 days, Atomic mass number of RaE is 210g and the Avacadro number is 6.023×10^{23}.

[2] What do you mean by elastic scattering?
An α –particle is elastically scattered from a proton which is initially at rest. Show that

$$\left(1 - \frac{M_p}{M_\alpha}\right) P_0^2 - 2P_0 P_1 \cos\theta_\alpha + \left(1 + \frac{M_p}{M_\alpha}\right) P_1^2 = 0$$

Where P_0 and P_1 are the initial and final momentum of the α - particle respectively.
θ_α is the angle between the direction of scattered α - particle and its original direction.
M_p, M_α are the masses of proton and α - particle respectively.

Show also that the minimum possible scattering angle θ_α is 14°29′ where, $M_p = 1$ amu and $M_\alpha = 4$ amu.