

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

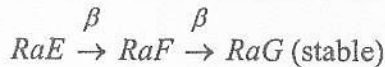
[1] Explain what is meant by chain disintegration.

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 $t_0 = \frac{\ln(\lambda_A / \lambda_B)}{\lambda_A - \lambda_B}$

Consider the decay scheme



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 $14^\circ 29'$ where,

$M_p = 1$ amu and $M_\alpha = 4$ amu.