EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2005/2006 (AUG-SEP. 2007)

FIRST SEMESTER

PH 303 – NUCLEAR PHYSICS

Time: 01 hour.

Answer ALL Questions.

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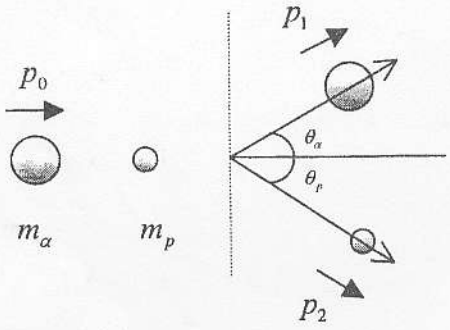
1. Define the decay constant λ, half-life $T_{1/2}$, mean-life $\overline{T}$ and the activity of a radioactive element.
Establish the relationships

$$\lambda^{-1} = T_{1/2}(\ln 2)^{-1} = \overline{T}$$

(a) A radioactive source contains 1 μg of uranium (mass number 235). The source is estimated to emit a total of 2000 α particles per second in all directions. Calculate the half-life of uranium.

(b) The numbers of disintegrations per minute of a certain radioactive substance are 6050 and 4465 at the 2nd and 3rd hour. Calculate the decay constant and half-life of the substance.

2. What do you mean by scattering process and elastic scattering?
An α particle is elastically scattered by a proton which is initially at rest.



Before scattering After scattering

Where p_0, p_1 and p_2 are momentum of the particles.
Show that

$$\left(1-\frac{m_p}{m_\alpha}\right)p_0^2 - 2p_0p_1\cos\theta_\alpha + \left(1+\frac{m_p}{m_\alpha}\right)p_1^2 = 0$$

and hence deduce that the maximum possible scattering angle for the α particle is 14°30′.