LTT-3307 RADIATION PHYSICS

Examination, October 6th, 2008

1. Compare the atomic models of Thompson, Rutherford and Bohr with each other.

2. Explain the principle of Compton scattering. What factors affect the energy of scattered photon? How does the amount of Compton scattering depend on the material and energy?

3. a. Principle of thermoluminescence (TLD)
   b. Use of TLD in measurement of radiation in medicine.

4. What physical interaction process is the basis of boron neutron capture therapy (BNCT)? How is the effect of the treatment focused in BNCT therapy?

5. The radioactive isotope ^{235}U decays to ^{231}Th with a half-life of $7.04*10^8$ years. ^{231}Th is also radioactive, with a half-life of 25.2 hours. Suppose we start with a two-gram sample of pure ^{235}U. What will be the activity of the sample at the end of one day (approximately one half-life of ^{231}Th), and what will be the activity of the sample after one month? M(^{235}U) = 235 g/mol and M(^{231}Th) = 231 g/mol.

COLLECTION OF FORMULAE FOR EXAMINATIONS OF RADIATION PHYSICS

$E_{kin} = \frac{p^2}{2m} = \frac{1}{2}mv^2$, v = velocity

$p = mv$, v = velocity

$\lambda = \frac{h}{p}$

$E = h\nu = \frac{hc}{\lambda}$, ν = frequency

$E_B = Zm_p c^2 + (A-Z)m_n c^2 - Mc^2 = \left(Zm_p + (A-Z)m_n - M\right)c^2$

$h\nu' = h\nu \frac{1}{1 + \frac{h\nu}{m_e c^2}(1-\cos\theta)}$

$\frac{1}{h\nu'} - \frac{1}{h\nu} = \frac{1}{m_e c^2}(1-\cos\theta)$, ν = frequency

$\Delta\lambda = \lambda' - \lambda = \lambda_c(1-\cos\theta)$, λ_c = 0.0243 Å (1Å=10^{-10} m)

$m(v) = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$, v = velocity

$E_{tot,rel} = \sqrt{p^2c^2 + m_0^2 c^4}$

$N = \frac{m \cdot N_A}{M}$

$A = \lambda N$

$N_B(t) = \frac{N_{0A}\lambda_A}{\lambda_B - \lambda_A}\left(e^{-\lambda_A t} - e^{-\lambda_B t}\right)$ Decay of A→ B → C

$I = I_0 e^{-\mu \cdot x} = I_0 e^{-\frac{\mu}{\rho}\rho \cdot x}$

h = 6.626076*10^{-34} Js = 4.135669*10^{-15} eVs
c = 3*10^{8} m/s
e = 1.6021773*10^{-19} C
m_e = 9.1093897*10^{-31} kg = 5.4857990*10^{-4} u
m_p = 1.6726231*10^{-27} kg = 1.0072765 u
m_n = 1.6749286*10^{-27} kg = 1.0086650 u
m_H = 1.007825 u
m_D = 2.014102 u
m_{He} = 4.002603 u
u = 1.6605402*10^{-27} kg
N_A = 6.0221367*10^{23} mol^{-1}