(Home works lecture 2)

Q2: Calculate the activity of ^{137}Cs after: (a) 2 years, (b) 15 years, (c) 30 years; if its activity at production was (10 μCi) and the half – life of ^{137}Cs is (30 years)?

A_o = 10 μCi (Activity at production)

$t_{1/2}$ = 30 y

(Activity at t) A = $A_o e^{-\lambda t}$

$\lambda = \frac{0.693}{t_{1/2}} = \frac{0.693}{30\ y}$ = 0.0231 y^{-1}

(a) (At t = 2 y) A= 10 μCi × $e^{-0.0231\ y^{-1} \times 2\ y}$ = 9.5 μCi

(b) (At t = 15 y) A= 10 μCi × $e^{-0.0231\ y^{-1} \times 15\ y}$ = 7 μCi

(c) (At t = 30 y) A= 10 μCi × $e^{-0.0231\ y^{-1} \times 30\ y}$ = 5 μCi

Q3: Radioactive element was produced at 8 – 1 – 2020 with radioactivity 5 mci half-life of this source is 5.6 y. calculate its activity on today's date?

A_o = 5 mCi (Activity at production)

$t_{1/2}$ = 5.6 y

$\lambda = \frac{0.693}{t_{1/2}} = \frac{0.693}{5.6\ y \times 365.25}$ = 0.00034 day^{-1}

t = (26 – 2 – 2024) – (5 – 1 – 2020) = 21 day + 1 month + 4 year

t = 21 day + 1 × 30 day + 4 × 365.25 = 1512 day

A = $A_o e^{-\lambda t}$

A= 5 mCi × $e^{-0.00034\ day^{-1} \times 1512\ day}$ = 5 mCi × 0.59 = 2.9 mCi

(Home Work lecture 4)

Examples 1: Gamma photon emitted from the cesium source ^{137}Cs, has energy 0.662 μeV, and was absorbed with the electron in the ground level of the hydrogen atom by the photoelectric interaction. Hydrogen binding energy 13.6 eV, calculate the kinetic energy of the electron?

فوتون كاما المنبعث من مصدر السيزيزم ^{137}Cs وطاقته 0.662μev امتصت مع الالكترون في المستوي الارضي لذرة الهيدروجين تفاعلا كهروضوئيا طاقة ربط الهيدروجين 13.6 eV احسب الطاقة الحركية للالكترون المتحرر؟

Answer:

$$h\upsilon = E_B + E_K$$

Where: $h\upsilon$ = Energy of incident photon.

E_B = Binding energy of electron.

E_K = Kinetic energy of electron.

$E_K = h\upsilon - E_B$ $\quad E_k = 0.662 \times 10^6$ eV – 13.6 e V = 661986.4 eV = 0.6619 μ eV

Example 2: Calculate the energy, frequency and wavelength of the scattered photons at an angle $\Phi = 90^\circ$ when the energy of the incident photons is 1.173 μeV; Calculate the kinetic energy of the outgoing electron?

احسب الطاقة والتردد والطول الموجي للفوتونات المستطارة بزاوية $\Phi = 90$ عندما تكون طاقة الفوتونات الساقطة 1.173 μ eV ثم احسب الطاقة الحركية للالكترون المتحرر؟

Answer:

$$h\upsilon^- = \frac{h\upsilon}{1+\frac{h\upsilon}{m_0c^2}(1-\cos\Phi)}$$

$$h\upsilon^- = \frac{1.173}{1+\frac{1.173}{0.511}(1-\cos 90)}$$

$h\upsilon^-$ **= 0.355 μ eV = 0.355 × 10^6 × 1.6 × 10^{-19} = 0.568 ×10^{-13} J**

E$^-$ = $h\upsilon^-$ $\quad$ **0.568 ×10^{-13} J = 6.6 × 10^{-34} J.S ×** υ^- $\quad \therefore \quad \upsilon^-$ **= 0.0856 × 10^{21} sec^{-1}**

$\mathbf{C = \lambda^- \times \upsilon^-}$ $\mathbf{\lambda^- = C / \upsilon^-}$ $\mathbf{\therefore \lambda^- = 3 \times 10^8\ ms^{-1} / 0.0856 \times 10^{21}\ sec^{-1} = 35.04 \times 10^{-13}\ m}$

$hv = hv^- + E_K$ $E_K = hv - hv^-$ $\therefore E_K$ = 1.173 μ eV – 0.355 μ eV = 0.818 μ eV

Example 3: Calculate the kinetic energy of the positron resulting from the pair production interaction when the energy of the incident photon is 2.022 μeV?

احسب الطاقة الحركية لبوزترون الناتج من تفاعل انتاج الزوج عندما تكون طاقة الفوتون الساقط 2.022 μ eV ؟

$hv = m_{o_{e-}}C^2 + m_{o_e}C^2 + E_{K_{e-}} + E_{K_e}$

$hv = 2\ m_0C^2 + 2\ E_k$ $2.022 = 2 \times 0.511 + 2\ E_k$

$2\ E_k = 1$ $\therefore E_k = 0.5$ μ eV

Example 4: Calculate the thickness of the water layer that reduces the number of photons to 80% of its original number? Where $(\mu_m)_{water}$= 0.0706 cm^2/g;ρ = 1g/cm^3

$(\mu_m)_{water}$= 0.0706 cm^2/g **احسب سمك طبقة الماء التي تقلل عدد الفوتونات الى 80% من عددها الاصلي حيث** ρ = 1g/cm^3 **؟**

$I = I_o e^{-\mu x}$

$\mu_m = \mu_l / \rho$ $\mu_l = \mu_m \times \rho$ μ_l = 0.0706 $cm^2/g \times 1g/cm^3$ = 0.0706 cm^{-1}

I = 0.8 I_o

$0.8\ I_o = I_o e^{-0.0706\ x}$

Ln 0.8 = - 0.0706 *x*

x = 3.16 cm