3. CIKLUS

(82) $Pb^{206}(d,p)Pb^{207}$ $\quad Q = 4,5\ MeV$

$Pb^{206}(n,\gamma)Pb^{207}$ $\quad Bd = 2,23\ MeV$

$E_\gamma = ?$

$Q = (m_{Pb(206)} + m_d - m_{Pb(207)} - m_p)c^2$

$m_{Pb(206)} \cdot c^2 + m_n c^2 + E_{kin} = m_{Pb(207)} c^2 + E_{vezavna} + E_\gamma$

$E_\gamma = m_{Pb(206)} \cdot c^2 - m_{Pb(207)} c^2 + m_n c^2$

$m_{Pb(206)} \cdot c^2 - m_{Pb(207)} c^2 = Q + m_p c^2 - m_d c^2$

$Bd = (m_p + m_n)c^2 - m_d c^2 \Rightarrow m_d \cdot c^2 = m_p c^2 + m_n c^2 - Bd$

$m_{Pb(206)} c^2 - m_{Pb(207)} c^2 = Q + m_p c^2 - m_p c^2 - m_n c^2 + Bd$

$E_\gamma = Q - m_n c^2 + Bd + m_p c^2$

$E_\gamma = Q + Bd = 4,5 + 2,23 = 6,73\ MeV$

(83) ${}^7_3Li\ (p,n)\ {}^7_4Be$ $\quad Q = -1,647\ MeV$

$E_{prага} = ?$

$E_{prага} = (-Q)\dfrac{m_{Be}}{m_{Be} - m_p} = 1,647 \cdot \dfrac{7}{6} = 1,88\ MeV$

16. zadatak:

$p_p = p_{Be}$

$m_{Li} c^2 + m_p c^2 + E_{prago} = m_n c^2 + m_{Be} c^2 + E_{n,Be} + E_{k_n}^{\phi}$

$Q + E_{prago} = E_{Be}$

$E_{Be} = \frac{m_{Be} \cdot v_{Be}^2}{2} = \frac{p_{Be}^2}{2 m_{Be}} = \frac{p_p^2}{2 m_p E_{prago}} \cdot \frac{m_p}{m_{Be}}$

$E_{Be} = E_{prago} \cdot \frac{m_p}{m_{Be}}$

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(84) ${}^{10}_{5}B(n,\alpha){}^{7}_{3}Li + 2{,}3\,MeV = Q$

$\delta x = 2 \cdot 10^{-3}\ g/cm^2$, $S = 1\,cm^2$

$E_n = 20\,MeV$ $\quad \phi = 10^5 \frac{neutrona}{cm^2 s}$ $\quad \alpha = 19{,}8\%$

$\underline{\beta = 20 \cdot 10^{-24}\ cm^2}$

$P = ?$

$P = \Delta \dot{N} \cdot E_{oslobodeno}$

$m_B c^2 + m_n c^2 + E_n = m_\alpha \cdot c^2 + m_{Li} \cdot c^2 + E_\alpha + E_{Li}$

$E_{oslob.} = E_\alpha + E_{Li} = Q + E_n = 22{,}3\,MeV$

$\Delta \dot{N} = \phi \cdot S \cdot \beta \cdot n$

/

broj jezgri B^{10} po cm^2 mete

$n = \frac{\rho x}{M_B} \cdot N_A$

$P = \phi \cdot \beta \cdot S \cdot \frac{\rho x}{M_B} N_A \cdot \alpha (E_\alpha + E_{Li})$ $\Rightarrow$

$P = 10^5 \cdot 2 \cdot 10^{-14} \cdot 1 \cdot \frac{2 \cdot 10}{10} \cdot 6{,}02 \cdot 10^{\cdots} \cdot 0{,}198 \cdot (22{,}3 \cdot \cdots)$ $\Rightarrow \frac{J}{s} = W$

$\boxed{P = 1{,}7 \cdot 10^{-10} W}$

86.) $m = 1\,kg$ U^{235} $\quad 1\,cal = 4{,}187\,J$

$q = 7000\ \frac{kcal}{g}$

Fisija 1 jezgre oslobodi se 200 MeV-a!

$E_{235} = N_{235} \cdot 200\,MeV \qquad A = 235$

broj jezgri

$\boxed{N = \frac{m}{A} \cdot N_A}$

$E_{235} = \frac{m}{A} \cdot N_A \cdot 200\,(MeV) \cdot 1{,}6 \cdot 10^{-3}\,J$

$= \frac{1}{235} \cdot 6{,}022 \cdot 10^{26} \cdot 200 \cdot 1{,}6 \cdot 10^{-3}$

$= \underline{8{,}2 \cdot 10^{13}\,J}$

$E_k = W \cdot q = 8{,}2 \cdot 10^{03} J$

$m_f = \frac{E_{235}}{q} = \frac{8{,}2 \cdot 10^{13} J}{7000 \cdot 4187\ J/kg} = \underline{0{,}2738 \cdot 10^{7}\,kg)}$

DOZIMETRIJA

1.) Snop elektrona elektrona energije 4 MeV jakosti struje 7 μA prolazi okomito kroz ravnu površinu uzorka nekog tkiva oblika diska promjera 2 cm, i debljine 0,5 cm. Kolika je srednja absorbirana doza D uzorka nekog tkiva?

$E = 4\,MeV$

$I = 75\,\mu A$

$2R = 2\,cm$

$d = 0{,}5\,cm$

$\dot{D} = ?$

$I = \dot{N} \cdot e$

$R = 0{,}53E - 0{,}16 \Rightarrow$ doseg elektrona

$\left(\frac{g}{cm^2}\right)$ $\quad$ $\downarrow$ $\quad$ MeV

$R = 0{,}53 \cdot 4 - 0{,}16 = 2{,}014\ g/cm^2$

$$R_{cm} = \frac{R\left(\frac{g}{cm^2}\right)}{\rho\left(\frac{g}{cm^3}\right)} = 2{,}014\,cm$$

$R' = R - d = 2{,}014 - 0{,}5 = 1{,}514 = 0{,}53E - 0{,}16$

$0{,}53E = 1{,}514 + 0{,}16 = 1{,}674\,cm$

$$E = \frac{1{,}674}{0{,}53} = 3{,}1585\,MeV$$

$\bar{E}_{aps} = E - E' = 4 - 3{,}1585 = 0{,}8415\,MeV$

$\downarrow$

srednja apsorpcijska energija

$$\dot{D} = \frac{\dot{N}\bar{E}_{aps}}{\rho V} = \frac{\dot{N} \cdot \bar{E}_{aps}}{\rho \cdot R^2 \pi d} = \frac{\frac{I}{e} \cdot \bar{E}_{apc}}{\rho \cdot R^2 \pi d}$$

$\rho \cdot V$ $\quad$ $R^2 \pi d$

$$\dot{D} = \frac{75 \cdot 10^{-6} \cdot 9{,}9385 \cdot 1{,}6 \cdot 10^{-13}}{1{,}1 \cdot 10^{-19} \cdot 1000 \cdot (10^{-2})^2 \pi \cdot 5 \cdot 10^{-3}} = 4{,}08 \cdot 10^{4}\,\frac{Gy}{s}$$

(2.) Radnik je primio jednaku dozu za cijelo tijelo od
0,3 mGy s time da je dobio dozu od 100 keV
neutrona
0,19 mGy od 1,5 MeV elektrona
4,3 mGy od gama zraka

$D_{100keV} = 0,3$ mGy
$D_{1,5MeV} = 0,19$ mGy
$D_\gamma = 4,3$ mGy

$Q_1 = 10$
$Q_2 = 20$
$Q_3 = 1$

$H = ?$

$H = Q_1 D_{100} + Q_2 D_{1,5} + Q_3 D_\gamma =$
$H = 10 \cdot 0,3 + 20 \cdot 0,19 + 1 \cdot 4,3 =$ **11,1 mSv**