الحلول المقترحة

التمرين الأول :

1/ حساب النقص في الكتلة :

$^{39}_{19}K\binom{19\,p}{20\,n}$, $^{40}_{19}K\binom{19\,p}{21\,n}$, $^{41}_{19}K\binom{19\,p}{22\,n}$

$\Delta m = |\ Z\ m_p + (A-Z)m_n - \ m_K\ |$

$\Delta m_1 = |\ [19\ (1{,}00728) + 20\ (1{,}00867)] - 38{,}9637\ |$

$\Delta m_1 = 0{,}3480\ Uma$

$\Delta m_2 = |\ [19\ (1{,}00728) + 21\ (1{,}00867)] - 39{,}9640\ |$

$\Delta m_2 = 0{,}3564\ Uma$

$\Delta m_3 = |\ [19\ (1{,}00728) + 22\ (1{,}00867)] - 40{,}9618\ |$

$\Delta m_3 = 0{,}3673\ Uma$

2/ حساب الطاقة النووية لكل نظير بـ Mev :

$\Delta E_N = \Delta m \times 931$

$\Delta E_{N1} = 0{,}3480 \times 931 \quad , \Delta E_{N1} = 323{,}988\ MeV$

$\Delta E_{N2} = 0{,}3564 \times 931 \quad , \Delta E_{N2} = 331{,}808\ MeV$

$\Delta E_{N3} = 0{,}3673 \times 931 \quad , \Delta E_{N3} = 341{,}956\ MeV$

3/ حساب طاقة النيوكليون ثم المقارنة بين استقرار الأنوية :

$$a_1 = \frac{\Delta E_{N1}}{A_1} = \frac{323{,}988}{39}, \qquad a_1 = 8{,}307\ MeV/Nucléon$$

$$a_2 = \frac{\Delta E_{N2}}{A_2} = \frac{331{,}808}{40}, \qquad a_2 = 8{,}295\ MeV/Nucléon$$

$$a_3 = \frac{\Delta E_{N3}}{A_3} = \frac{341{,}956}{41}, \qquad a_2 = 8{,}340\ MeV/Nucléon$$

العنصر الذي يحتاج طاقة أكبر هو الأكثر استقرار إذن:

$$^{41}K\ >\ ^{39}K\ >\ ^{40}K$$

التمرين الثاني:

(1

$^{130}_{52}Te + {}^{2}_{1}d \rightarrow {}^{130}_{53}\mathrm{I} + 2\ {}^{1}_{0}n + \Delta E_N$

$^{40}_{18}Ar + {}^{4}_{2}\alpha \rightarrow {}^{43}_{19}\mathrm{K} + {}^{1}_{1}P + \Delta E_N$

$^{55}_{25}Mn + {}^{1}_{0}n \rightarrow {}^{56}_{25}\mathrm{Mn} + {}^{0}_{0}\gamma + \Delta E_N$

$^{15}_{8}O \rightarrow {}^{15}_{7}N + {}^{0}_{+1}\beta + \Delta E_N$

$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta + \Delta E_N$

(2

$^{56}_{25}Mn \rightarrow {}^{56}_{26}Fe + {}^{0}_{-1}\beta + \Delta E_N$

1mol (Mn) 56g → (Fe) 49g

m_0 m' (ناتجة)

$m_{المتبقية} = m_0 - m' = 56 - 49 = 7\ g$

$m = m_0 \times e^{-\lambda t} \Rightarrow \frac{m}{m_0} = e^{-\lambda t}\ \alpha \Rightarrow Ln\ \frac{m_0}{m} = \lambda t$ (3

$\Rightarrow \lambda = \frac{1}{t} \times Ln\ \frac{m_0}{m} = \frac{1}{7{,}5} \times Ln\ \frac{56}{7}$

$\Rightarrow \lambda = 0{,}277\ h^{-1}$

$T = \frac{Ln\ 2}{\lambda} = 2{,}49\ h = 8964\ Sec$

$A_0 = \lambda \times N_0 \Rightarrow A_0 = \lambda \times n_0 \times \mathcal{N}_A \Rightarrow A_0 = \lambda \times \frac{m_0}{M} \times \mathcal{N}_A$ (4

$\Rightarrow m_0 = \frac{A_0 \times M}{\lambda \times \mathcal{N}_A}$

$\lambda = \frac{Ln\ 2}{T} \Rightarrow m_0 = \frac{A \times M \times T}{\mathcal{N}_A \times Ln\ 2} = \frac{2 \times 10^6 \times 3{,}7 \times 10^{10} \times 56 \times 8964}{6{,}023 \times 10^{23} \times Ln\ 2}$

$\Rightarrow m_0 = 0{,}08899\ \text{g} = 88{,}99\ \text{mg}$

$\Delta m = |m_{Fe} - m_{Mn}| = 55{,}93493 - 55{,}93948$ (5

$\Delta m = 0{,}00455\ \text{Uma}$

$\Delta E_N = \Delta m \times 931 = 0{,}00455 \times 931$

$\Delta E_N = 4{,}23605\ MeV$

$\Delta E_N\ (1mol) = \Delta E_N \times \mathcal{N}_A = 4{,}23605 \times 6{,}023 \times 10^{23}$

$\Delta E_N\ (1mol) = 2{,}55 \times 10^{24}\ MeV$

التمرين الثالث:

${}^{60}_{27}X \rightarrow {}^{60}_{28}Y + {}^{0}_{-1}\beta + \Delta E_N$ (1

$m_0 = 0{,}012\ Kg \xrightarrow{t=15j} N'_{\text{ناتجة}} = 9{,}0345 \times 10^{22}\ Noyaux$ (2

$N_0 = \frac{m_0}{M} \times \mathcal{N}_A \rightarrow \quad N'$

$N = N_0 \times e^{-\lambda t}$, $N_{\text{متبقية}} = N_0 - N'_{\text{ناتجة}}$

$\Rightarrow N_0 - N' = N_0 \times e^{-\lambda t} \Rightarrow N' = N_0 - N_0 \times e^{-\lambda t} \Rightarrow N' = N_0 \times \left(1 - e^{-\lambda t}\right)$

$N_0 = \frac{m_0}{M} \times \mathcal{N}_A$; $\lambda = \frac{Ln\ 2}{T}$ بما أن :

$\Rightarrow N' = \frac{m_0}{M} \times \mathcal{N}_A \times \left(1 - e^{-\frac{Ln2}{T}t}\right)$

$\Rightarrow \frac{N' \times M}{m_0 \times \mathcal{N}_A} = 1 - e^{-\frac{Ln2}{T}t} \Rightarrow 1 - \frac{N' \times M}{m_0 \times \mathcal{N}_A} = e^{-\frac{Ln2}{T}t} \Rightarrow Ln\left(1 - \frac{N' \times M}{m_0 \times \mathcal{N}_A}\right) = -\frac{Ln2}{T}t$

$\Rightarrow T = \frac{-t \times Ln2}{Ln\left(1 - \frac{N' \times M}{m_0 \times \mathcal{N}_A}\right)} = \frac{-15\text{j} \times Ln2}{Ln\left(1 - \frac{9{,}0345 \times 60 \times 10^{-3}}{0{,}012 \times 6.023 \times 10^{23}}\right)}$

$\Rightarrow T = 7{,}5\ \text{j}$

(3

$$A = \lambda \times N = \lambda \times N_0 \times e^{-\lambda t} \; ; N_0 = \frac{m_0}{M} \times \mathcal{N}_A \; ; \lambda = \frac{Ln\,2}{T}$$

$$\Rightarrow A = \frac{Ln2}{T} \times \frac{m_0}{M} \times \mathcal{N}_A \times e^{-\frac{Ln2}{T}t}$$

$$A = \frac{Ln2}{7{,}5 \times 24 \times 3600} \times \frac{12 \times 6{,}023 \times 10^{23}}{60} \times e^{-\frac{Ln2}{7.5\,\text{j}}.30\,\text{j}}$$

$$A = 8{,}05 \times 10^{15}\ DPS$$

$$A = 2{,}18 \times 10^{5}\ Ci$$

التمرين الرابع:

(1

1 mol : 57,5 g (NaCl) → 22 g (Na)

$$10 \times 10^{-3}\text{g} \rightarrow m_0$$

$$m_0(Na) = 3{,}83 \times 10^{-3}\ g$$

$$A_0 = \lambda \times N_0 = \lambda \times n_0 \times \mathcal{N}_A = \lambda \times \frac{m_0}{M} \times \mathcal{N}_A$$

$$\Rightarrow \lambda = \frac{A_0 \times M}{m_0 \times \mathcal{N}_A} = \frac{8.85 \times 10^{11} \times 22 \times 10^{-3}}{3.83 \times 10^{-3} \times 10^{-3} \times 6.023 \times 10^{23}} \Rightarrow \lambda = 8{,}45 \times 10^{-9}\ Sec^{-1}$$

$$T = \frac{Ln\,2}{\lambda} = \frac{Ln2}{8{,}45 \times 10^{-9}} = 8{,}2 \times 10^{7}\ Sec$$

(2

$N_0 = 100$, $N = 25$

$$N = N_0 \times e^{-\lambda t} \Rightarrow t = \frac{1}{\lambda}\, Ln\, \frac{N_0}{N} = \frac{1}{8.45 \times 10^{-9}}\, Ln\, \frac{100}{25}$$

$$t = 1{,}64 \times 10^{8} Sec$$

(3

$N_0 = 100$, $N'_{\text{متهافتة}} = 1$, $N_{\text{متبقية}} = 99$

$$t = \frac{1}{\lambda}\, Ln\, \frac{100}{99} = \frac{1}{8{,}45 \times 10^{-9}}\, Ln\, \frac{100}{99}$$

$$t = 1{,}19 \times 10^{6} Sec$$

(4

A_0 , $A = \frac{A_0}{1000} = A_0 \times 10^{-3}$

$$A = A_0 \times e^{-\lambda t} \Rightarrow t = \frac{1}{\lambda}\, Ln\, \frac{A_0}{A_0 \times 10^{-3}}$$

$$t = 8{,}17 \times 10^{8}\ Sec$$