2005 핵공학개론1 2차 중간고사 답안지

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1.

(가) $A(t) = \lambda N(t)$

$N(t) = N_0 \cdot exp(-\lambda t)$

$A(t) = \frac{1}{2} A_0$

Sol 1)

$$\frac{1}{2}(0.5 + 0.02) = 0.5e^{(-\frac{ln2}{2.7}t)} + 0.02e^{(-\frac{ln2}{8.05}t)}$$

($\because t_{1/2}(I) \cong 3t_{1/2}(AU)$, x=$e^{(-\frac{ln2}{8.05}t)}$ 치환)

$x^3 + 0.04x = 0.52$

$x \simeq 0.7875$

$t = 2.7744$ (day)

Sol 2)

$0.96\lambda_{Au} + 0.04\lambda_I = \lambda_{sample}$

$t_{1/2} = ln2/\lambda_{sample}$

$\therefore t_{1/2}$ =2.7737 (day)

(나) 2일 ~ 2.5일에 붕괴되는 Au의 양

$N_{Au}(0) \cdot \int_2^{2.5} \lambda e^{-\lambda t} dt$

$= N_{Au}(0)[exp(-\lambda_{Au} \cdot 2) - exp(-\lambda_{Au} \cdot 2.5)]$

$= N_{Au}(0)[exp(-\frac{ln2}{2.7} \times 2) - exp(-\frac{ln2}{2.7} \times 2.5)] = 0.07208 N_{Au}(0)$

$\therefore 7.208(\%)$

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2.

$\beta(t) = 3.8 \times 10^{-6} \times t^{-1.2}$

$\gamma(t) = 1.9 \times 10^{-6} \times t^{-1.2}$

$e(t) = \beta(t) + \gamma(t) = 5.7 \times 10^{-6} \times t^{-1.2}$

P(Mwatt) = $P \times 10^{6}(Watt) = P \times 10^{6}(J/sec) = P \times 10^{6} \times \dfrac{1}{1.602 \times 10^{-13}}$

$= P \times 6.242 \times 10^{18} (MeV/sec)$

$= 6.242 \times 10^{18} / 200 \, (MeV/fission) = 3.121 \times 10^{16} \times P(fission/sec)$

원자로를 시간 T 만큼 가동한 후 정지후 t시간의 activity

Activity = $\int_0^T 5.7 \times 10^{-6} (T + t - t')^{-1.2} \times 3.121 \times 10^{16} \times P \cdot dt'$

$= \int_0^T 1.78 \times 10^{11} \times P(T + t - t') \cdot dt'$

$= \int_{t+T}^{t} 1.78 \times 10^{11} \times P(t'')^{-1.2} \cdot (-dt'')$

$= 1.78 \times 10^{11} \times P \times \dfrac{1}{0.2} \times (t'')^{-0.2} \Big|_{t+T}^{t}$

$= 8.9 \times 10^{11} \times P\{t^{-0.2} - (t+T)^{-0.2}\}$ (dps)

$= 24 \times P \times \{t^{-0.2} - (t+T)^{-0.2}\} \, (curie)$

3.

$R = \sigma \cdot I \cdot NAt$

$N_c = \dfrac{6.023 \times 10^{23} (\#/mole)}{12.0 \, (g/mole)} \times 1.60 \, (g/cm^3) = 8.03 \times 10^{22} (\#/cm^3)$

(가) $R = (2.6 \times 10^{-24}) \cdot (10^{9}) \cdot (8.03 \times 10^{22}) \cdot (0.1) \times (0.05)$

$= 1.044 \times 10^{6}$ (Reactions /sec)

(나) $R/I = 1.044 \times 10^{6} / (10^{9} \times 0.1) = 1.044 \times 10^{-2} (cm^2/\#)$

(다) $\sigma N \cdot I = (2.6 \times 10^{-24}) \cdot (8.03 \times 10^{22}) \cdot (10^{9}) = 2.09 \times 10^{8} (\#/sec \cdot cm^3)$

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(라) $l = \frac{1}{\Sigma} = \frac{1}{2.6 \times 10^{-24}(cm^2) \times 8.03 \times 10^{22}(cm^3)} = 4.79\,(cm)$

4.

$\sigma_t = \sigma_s + \sigma_a$

$\sigma_s = \sigma_n + \sigma_{n'}$

$\sigma_a = \sigma_f + \sigma_\gamma + etc$

(가) $\frac{\sigma_f}{\sigma_t} = \frac{582}{8 + 99 + 582} = 0.8447$

(나) $\frac{\sigma_n}{\sigma_t} = \frac{8}{8 + 99 + 582} = 0.0116$

(다) $\frac{\sigma_f}{\sigma_a} \times 100 = \frac{582}{99 + 582} \times 100 = 85.46(\%)$

5.

(가) $E = \frac{1}{2}mv^2 = 1/40(\text{eV})$

m(n) = 1.675×10^{-27} (kg)

$v = \sqrt{\frac{2 \cdot E \times 1.602 \times 10^{-19}}{m}}$

$\therefore v = (2 \times (1/40 \times 1.602 \times 10^{-19}) \div (1.675 \times 10^{-27}))^{1/2}$

$= 2186.7$ (m/s)

$I = n \cdot v$

$I_1 = 3 \times 10^8 \times 2186.7 \times 10^2 = 6.56 \times 10^{13}$ $(\#/cm^2 \cdot sec)$

$I_2 = 4 \times 10^8 \times 2186.7 \times 10^2 = 8.75 \times 10^{13}$ $(\#/cm^2 \cdot sec)$

(나) $\Phi = n \cdot v = I_1 + I_2 = 1.53 \times 10^{14}$ $(\#/cm^2 \cdot sec)$

(다) 열중성자

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