

(9)

 ^{201}Bi

$$A_1(0) = 450 \text{ kBq} \quad T_{1/2,1} = 7,8 \text{ h}$$

 ^{201}Pb

$$A_2(0) = 7 \text{ kBq} \quad T_{1/2,2} = 9,5 \text{ h}$$

$$A_{2, \text{max}} = ?$$

$$\lambda_1 = \frac{\ln 2}{T_{1/2,1}} = \frac{\ln 2}{6480} = 7,0697 \cdot 10^{-4} \text{ s}^{-1}$$

$$\lambda_2 = \frac{\ln 2}{T_{1/2,2}} = 2,07 \cdot 10^{-5} \text{ s}^{-1}$$

$$\frac{dN_i}{dt} = \lambda_{i-1} N_{i-1} - \lambda_i N_i \quad A_i = -\frac{dN_i}{dt}$$

$$N_1 = C_{11} e^{-\lambda_1 t}$$

$$N_2 = C_{21} e^{-\lambda_1 t} + C_{22} e^{-\lambda_2 t}$$

$$C_{ij} = C_{i-1,j} \frac{\lambda_{i-1}}{\lambda_i - \lambda_j}$$

$$A_1(0) = C_{11} \lambda_1 \Rightarrow C_{11} = \frac{A_1(0)}{\lambda_1} = 4,27 \cdot 10^9$$

$$C_{21} = C_{11} \frac{\lambda_1}{\lambda_2 - \lambda_1} = -5,2 \cdot 10^9$$

$$A_2(0) = \lambda_2 N_2(0) - \lambda_1 N_1(0) = \lambda_2 (C_{21} + C_{22}) - \lambda_1 C_{11} \Rightarrow C_{22} = \frac{A_2(0) + \lambda_1 C_{11}}{\lambda_2} - C_{21}$$

$$C_{22} = 2,729 \cdot 10^{10}$$

$$A_2(t) = \lambda_2 N_2(t) - \lambda_1 N_1(t) = \lambda_2 C_{21} e^{-\lambda_1 t} + \lambda_2 C_{22} e^{-\lambda_2 t} - \lambda_1 C_{11} e^{-\lambda_1 t}$$

$$\frac{dA_2}{dt} = -\lambda_2 \lambda_1 C_{21} e^{-\lambda_1 t} - \lambda_2^2 C_{22} e^{-\lambda_2 t} + \lambda_1^2 C_{11} e^{-\lambda_1 t} = 0$$

$$e^{-\lambda_2 t + \lambda_1 t} = \frac{C_{11} \lambda_1^2 - C_{21} \lambda_2 \lambda_1}{\lambda_2^2 C_{22}}$$

$$A_{\text{max}} = \frac{\ln \left(\frac{C_{11} \lambda_1^2 - \lambda_2 \lambda_1 C_{21}}{C_{22} \lambda_2^2} \right)}{\lambda_1 - \lambda_2}$$

$$A_m = 18892 \text{ s}$$

$$A_2(A_{\text{max}}) = \lambda_2 C_{21} e^{-\lambda_1 A_m} + \lambda_2 C_{22} e^{-\lambda_2 A_m} - \lambda_1 C_{11} e^{-\lambda_1 A_m}$$

$$A_2(A_{\text{max}}) = 308145 \text{ Bq}$$