

$$1. (a) \frac{1}{T_E} = \frac{1}{T_R} + \frac{1}{T_B}$$

$$T_E = \frac{T_R \times T_B}{T_R + T_B} = \frac{8.05 \times 138}{8.05 + 138} = 7.60 \text{ days}$$

$$(b) \frac{dq(t)}{dt} = -(\lambda_R + \lambda_B)t = -\lambda_E t$$

$$q(t) = q_0 e^{-\lambda_E t} = (0.2 \times 1)(e^{-0.0912 \text{ days}^{-1} t}) \text{ [MBq]}$$

$$(0.0912 \text{ days}^{-1} = 1.055 \times 10^{-6} \text{ sec}^{-1})$$

$$(c) H_{50} = 1.6 \times 10^{-10} \times U_{I-131} \times SEE(\text{thyroid} \leftarrow \text{thyroid})_{I-131}$$

$$U_{I-131} \approx \frac{q_0}{\lambda_E} = \frac{0.2 \times 1 \times 10^6 \text{ tps}}{1.055 \times 10^{-6} \text{ sec}^{-1}} = 1.895 \times 10^{11} \text{ transformations}$$

$$SEE = \frac{\sum_R f_R E_R AF(T \leftarrow S)_R w_R N_R}{M_T} = \frac{f_R E_{\beta}^R (1)(1)(1) + f_R E_{\gamma}^R AF(T \leftarrow T)_R (1)(1)}{20}$$

$$= 0.0114 \text{ Mev/g} \cdot t$$

$$\therefore H_{50} = (1.6 \times 10^{-10})(1.895 \times 10^{11})(0.0114) = 0.346 \text{ Sv}$$

2. (a) 우유를 먹기 시작한 시점을  $t=0$ 라 하면

$$\frac{dq}{dt} = R - \lambda_E t$$

$R =$  섭취에 의한 증가율 ( $0.3 \times 900 \text{ pCi/day}$ )

$$\text{위 식을 풀면, } q(0) = 0, \quad q(t) = \frac{R}{\lambda_E} (1 - e^{-\lambda_E t})$$

따라서 30일 지난 시점의 activity는

$$q(30) = \frac{0.3 \times 900 \text{ pCi/day}}{0.0912 \text{ day}^{-1}} (1 - \exp(-0.0912 \times 30)) = 2.769 \times 10^3 \text{ pCi}$$

다시 30일이 지난 시점을  $t=0$ 라고 한다면

$$q(t) = 2.769 \times 10^{-6} \times \exp(-0.0912t) \text{ [mCi]}$$

$$(b) H = (1.6 \times 10^{-10}) q(t) \cdot SEE$$

$$= (2.769 \times \exp(-0.0912t))(3.7 \times 10^7 \text{ tps})(0.0114 \text{ Mev/g} \cdot t)(1.6 \times 10^{-10})$$

$$= 1.869 \times 10^{-10} \times \exp(-0.0912t) \text{ [Sv/sec]}$$

$$= 6.727 \times 10^{-2} \times \exp(-0.0912t) \text{ [mrem/hr]}$$

$$(c) H_{50} = (1.6 \times 10^{-10}) \cdot U_{I-131} \cdot SEE$$

$$U_{I-131} = \int_0^{30d} \frac{R}{\lambda_E} (1 - \exp(-\lambda_E t)) dt + \int_0^{50y} (2.769 \times 10^{-6} \text{ mCi} \times \exp(-\lambda_E t)) dt$$

$$\begin{aligned}
&= \frac{R}{\lambda_E} \left[ t + \frac{1}{\lambda_E} \exp(-\lambda_E t) \right]_0^{30d} + \frac{2.769 \times 10^{-6} \text{mCi}}{\lambda_E} \\
&= (1.869 \times 10^8) + (9.706 \times 10^7) \\
&= 2.84 \times 10^8 \text{ transformations} \\
\therefore H_{50} &= (1.6 \times 10^{-10})(2.84 \times 10^8)(0.0114) = 5.18 \times 10^{-4} \text{Sv} \\
&= 0.518 \text{mSv}
\end{aligned}$$

$$(d) (0.25 \times 10^{-2})(5.18 \times 10^{-4}) = 1.295 \times 10^{-6}$$

3. note 참조