Answer on Question # 84420, Physics / Atomic and Nuclear Physics

Question 1. *The disintegration constant of* $238U$ *is* $\lambda = 4.87 \cdot 10^{-18} s^{-1}$. *Calculate its half-life* $t_{1/2}$ *(in years). Also calculate the number of disintegration per second from* $m = 1$ *gram of Uranium. It is given that Avogadro's number* $N_A = 6.02 \cdot 10^{23}$.

Solution.

$$t_{1/2} = \frac{\ln 2}{\lambda} = \frac{0.693}{4.87 \cdot 10^{-18}} \approx 0.14 \cdot 10^{18}\, s \approx 4.5 \cdot 10^{9}\, y.$$

The atomic mass of $238U$ is $M = 238\, u$. $\nu = \dfrac{m}{M} = \dfrac{N}{N_A} \Rightarrow N = \dfrac{mN_A}{M}$. The number of decays per second of a radioactive sample is

$$A = \lambda N = \frac{\lambda m N_A}{M} \approx 12318\, s^{-1}.$$

□