Answer on Question#38468, Physics, Nuclear Physics

Question:

Radon disintegration product of radium is in equilibrium with 1g of radium. Find the mass of radon

Answer:

Secular equilibrium can occur in a radioactive decay chain if the half-life of the daughter radionuclide B is much shorter than the half-life of the parent radionuclide A. The quantity of radionuclide B equals:

$$N_B = \frac{\lambda_A}{\lambda_B} N_A$$

where λ_A and λ_B are the decay constants of radionuclide A and B related to their half-lives $t_{\frac{1}{2}}$ by $\lambda = ln(2)/t_{\frac{1}{2}}$, N_A is quantity of radionuclide A.

Therefore:

$$N_B = \frac{t_{\frac{1}{2}B}}{t_{\frac{1}{2}A}} N_A$$

In our case:

$$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + \alpha$$

$$N_{Rn} = \frac{t_{\frac{1}{2}Rn}}{t_{\frac{1}{2}Ra}} N_{Ra}$$

Mass of N_{Rn} atoms of radon equals:

$$m_{Rn} = \frac{t_{\frac{1}{2}Rn}}{t_{\frac{1}{2}Ra}} N_{Ra} \frac{M_{Rn}}{N_A} = \frac{t_{\frac{1}{2}Rn}}{t_{\frac{1}{2}Ra}} \frac{M_{Rn}}{M_{Ra}} m_{Ra} = 6.4 * 10^{-6}\ g$$

Where M_{Rn} and M_{Ra} are molar masses.

Answer: $6.4 * 10^{-6}\ g$