

- A medical procedure requires 15.0 mg of ^{111}In . What mass of isotope would be required to be able to use it exactly 4 days later? The half life of ^{111}In is 2.80 days.

Marks
2

With a half life, $t_{1/2} = 2.80$ days, the activity coefficient, λ , is:

$$\lambda = \ln 2 / t_{1/2} = (\ln 2 / 2.80) \text{ days}^{-1} = 0.248 \text{ days}^{-1}$$

The amount of isotope at time t is related to the initial amount using $\ln(N_0/N_t) = \lambda t$. With $N_t = 15.0$ mg left after $t = 4$ days, the initial mass required is therefore:

$$\ln(N_0/N_t) = \lambda t$$

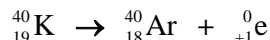
$$\ln(N_0 / 15.0) = (0.248 \text{ days}^{-1}) \times (4 \text{ days})$$

$$N_0 = 40.4 \text{ mg}$$

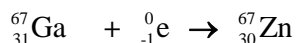
Answer: **40.4 mg**

- Write balanced nuclear equations for the following reactions.
Positron decay of potassium-40.

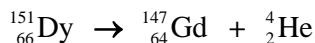
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Electron capture by gallium-67.



Alpha decay of dysprosium-151.



- Briefly explain the apparent contradiction between the following statements.
“Alpha particles are easily stopped by the skin.”
“The alpha-emitter, radon, is thought to be a significant cause of cancer.”

1

Radon is a gas, so can be inhaled. The alpha particles are therefore generated in the lungs and can cause direct damage without needing to penetrate the skin.