Marks

- 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. **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. **3**

Positron decay of potassium-40.

$${}^{40}_{19}\text{K} \rightarrow {}^{40}_{18}\text{Ar} + {}^{0}_{+1}\text{e}$$

Electron capture by gallium-67.

$${}^{67}_{31}\text{Ga} + {}^{0}_{-1}\text{e} \rightarrow {}^{67}_{30}\text{Zn}$$

Alpha decay of dysprosium-151.

$${}^{151}_{66}\text{Dy} \rightarrow {}^{147}_{64}\text{Gd} + {}^{4}_{2}\text{He}$$

- Briefly explain the apparent contradiction between the following statements. **1**

"Alpha particles are easily stopped by the skin."
"The alpha-emitter, radon, is thought to be a significant cause of cancer."

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.