47. The fraction of undecayed nuclei remaining after time t is given by

$$\frac{N}{N_0} = e^{-\lambda t} = e^{-(\ln 2)t/T_{1/2}}$$

where λ is the disintegration constant and $T_{1/2}$ $(= (\ln 2)/\lambda)$ is the half-life. The time for half the original ^{238}U nuclei to decay is 4.5×10^9 y. For ^{244}Pu at that time,

$$\frac{(\ln 2)t}{T_{1/2}} = \frac{(\ln 2)(4.5 \times 10^9\,\text{y})}{8.2 \times 10^7\,\text{y}} = 38.0$$

and

$$\frac{N}{N_0} = e^{-38.0} = 3.1 \times 10^{-17}\ .$$

For ^{248}Cm at that time,

$$\frac{(\ln 2)t}{T_{1/2}} = \frac{(\ln 2)(4.5 \times 10^9\,\text{y})}{3.4 \times 10^5\,\text{y}} = 9170$$

and

$$\frac{N}{N_0} = e^{-9170} = 3.31 \times 10^{-3983}\ .$$

For any reasonably sized sample this is less than one nucleus and may be taken to be zero. A standard calculator probably cannot evaluate e^{-9170} directly. Our recommendation is to treat it as $(e^{-91.70})^{100}$.