44. (a) The rate at which Radium-226 is decaying is

$$R = \lambda N = \left(\frac{\ln 2}{T_{1/2}}\right)\left(\frac{M}{m}\right) = \frac{(\ln 2)(1.00\,\mathrm{mg})(6.02\times 10^{23}/\mathrm{mol})}{(1600\,\mathrm{y})(3.15\times 10^{7}\,\mathrm{s/y})(226\,\mathrm{g/mol})} = 3.66\times 10^{7}\ \mathrm{s}^{-1}\ .$$

(b) Since $1600\,\mathrm{y} \gg 3.82\,\mathrm{d}$ the time required is $t \gg 3.82\,\mathrm{d}$.

(c) It is decaying at the same rate as it is produced, or $R = 3.66\times 10^{7}\,\mathrm{s}^{-1}$.

(d) From $R_{\mathrm{Ra}} = R_{\mathrm{Rn}}$ and $R = \lambda N = (\ln 2/T_{1/2})(M/m)$, we get

$$\begin{aligned} M_{\mathrm{Rn}} &= \left(\frac{T_{1/2\mathrm{Rn}}}{T_{1/2\mathrm{Ra}}}\right)\left(\frac{m_{\mathrm{Rn}}}{m_{\mathrm{Ra}}}\right) M_{\mathrm{Ra}} \\ &= \frac{(3.82\,\mathrm{d})(1.00\times 10^{-3}\,\mathrm{g})(222\,\mathrm{u})}{(1600\,\mathrm{y})(365\,\mathrm{d/y})(226\,\mathrm{u})} \\ &= 6.42\times 10^{-9}\ \mathrm{g}\ . \end{aligned}$$