

20. (a) We solve  $Q_{\text{eff}}$  from  $P = RQ_{\text{eff}}$ :

$$\begin{aligned} Q_{\text{eff}} &= \frac{P}{R} = \frac{P}{N\lambda} = \frac{mPT_{1/2}}{M \ln 2} \\ &= \frac{(90.0 \text{ u})(1.66 \times 10^{-27} \text{ kg/u})(0.93 \text{ W})(29 \text{ y})(3.15 \times 10^7 \text{ s/y})}{(1.00 \times 10^{-3} \text{ kg})(\ln 2)(1.60 \times 10^{-13} \text{ J/MeV})} \\ &= 1.2 \text{ MeV} . \end{aligned}$$

(b) The amount of  $^{90}\text{Sr}$  needed is

$$M = \frac{150 \text{ W}}{(0.050)(0.93 \text{ W/g})} = 3.2 \text{ kg} .$$