EXAMPLE 30-13

$$N = N_0 e^{-\lambda t}$$

$$200\,g \times \frac{1\,mol}{12\,g} \times \frac{6.022 \times 10^{23}\ ATOMS}{1\,mol} = 1.0 \times 10^{25}$$

↑ TOTAL NUMBER OF CARBON ATOMS (MOSTLY CARBON-12)

$$N_0 = (1.3 \times 10^{-12})(1.0 \times 10^{25}) = 1.3 \times 10^{13}$$

$$\lambda = \frac{\ln 2}{T_{1/2}} = \frac{\ln 2}{5730\ yr} = 1.21 \times 10^{-4}\ yr^{-1}$$

$$\lambda N = 16\ \text{DECAYS/s}$$

$$16\ \frac{\text{DECAYS}}{s} \times \frac{3600\,s}{1\,HR} \times \frac{24\,HR}{1\,DAY} \times \frac{365\ DAYS}{1\,yr} = 5.04 \times 10^{8}\ \text{DECAY/yr}$$

$$N = \frac{5.04 \times 10^{8}\ \text{DEC/yr}}{1.21 \times 10^{-4}\ yr^{-1}} = 4.2 \times 10^{12}$$

$$N = N_0 e^{-\lambda t}$$

$$\frac{N}{N_0} = e^{-\lambda t}$$

$$\ln\left(\frac{N}{N_0}\right) = -\lambda t$$

$$t = -\frac{1}{\lambda} \ln\left(\frac{N}{N_0}\right)$$

$$= -\frac{1}{1.21 \times 10^{-4}\ \text{yr}^{-1}} \ln\left(\frac{4.2 \times 10^{12}}{1.3 \times 10^{13}}\right)$$

$$= 9400\ \text{yrs}$$

(G6, Ch 30, P56)

$$290\,g \times \frac{1\,mol}{12\,g} \times \frac{6.022\times10^{23}\ \text{ATOMS}}{1\,mol} = 1.45\times10^{25}$$

↑ # ATOMS MOSTLY CARBON-12

$$N_o = (1.3\times10^{-12})(1.45\times10^{25}) = 1.89\times10^{13}$$

$$\lambda = 1.21\times10^{-4}\ yr^{-1}$$

$$8\ \text{DECAYS/s} = 2.52\times10^{8}\ \text{DECAYS/yr}$$

$$\lambda N = 2.52\times10^{8}\ \text{DECAYS/yr}$$

$$N = \frac{2.52\times10^{8}\ yr^{-1}}{1.21\times10^{-4}\ yr^{-1}} = 2.08\times10^{12}$$

$$t = -\frac{1}{\lambda}\ln\left(\frac{N}{N_o}\right)$$

$$= -\frac{1}{1.21\times10^{-4}\ yr^{-1}}\ln\left(\frac{2.08\times10^{12}}{1.89\times10^{13}}\right)$$

$$= 18{,}200\ yr$$