Quiz 31.1B

The activity of a sample of Iodine-131 is 0.355 Curies. The half-life of I-131 is 8.02 days. Assume the mass of a single atom of Iodine-131 is 131 u.

a) How many grams of Iodine-131 are in this sample?
b) After how many days will the activity of the sample be reduced to 0.0100 Curies?

$$a_0 = 0.355\ Ci \cdot \frac{1\ Bq}{2.7 \times 10^{-11}\ Ci} = 1.315 \times 10^{10}\ Bq$$

$$T_{1/2} = 8.02\ days \cdot \frac{24\ hr}{day} \cdot \frac{3600\ s}{hr} = 6.93 \times 10^5\ s$$

$$\lambda = \frac{0.693}{T_{1/2}} = 1.00 \times 10^{-6}\ s^{-1}$$

$$a_0 = \lambda N_0$$

$$1.315 \times 10^{10} = (1.00 \times 10^{-6}) N_0$$

$$\Rightarrow N_0 = 1.315 \times 10^{16}\ atoms$$

$$M_{TOT} = N_0 m_I = (1.315 \times 10^{16})(131\ u)(1.66 \times 10^{-24}\ \tfrac{g}{u})$$

$$= \boxed{2.86 \times 10^{-6}\ g}$$

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b) $0.01 = 0.355 e^{-\lambda t}$

$$0.02817 = e^{-\lambda t}$$

$$-3.569 = -(1.00 \times 10^{-6}) t$$

$$t = 3.569 \times 10^6\ s \cdot \frac{1\ day}{86400\ s} = \boxed{41.3\ days}$$