

34. We are given the energy release per fusion ($Q = 3.27 \text{ MeV} = 5.24 \times 10^{-13} \text{ J}$) and that a pair of deuterium atoms are consumed in each fusion event. To find how many pairs of deuterium atoms are in the sample, we adapt Eq. 43-20:

$$N_{d \text{ pairs}} = \frac{M_{\text{sam}}}{2M_d} N_A = \left(\frac{1000 \text{ g}}{2(2.0 \text{ g/mol})} \right) (6.02 \times 10^{23} / \text{mol}) = 1.5 \times 10^{26} .$$

Multiplying this by Q gives the total energy released: $7.9 \times 10^{13} \text{ J}$. Keeping in mind that a Watt is a Joule per second, we have

$$t = \frac{7.9 \times 10^{13} \text{ J}}{100 \text{ W}} = 7.9 \times 10^{11} \text{ s} = 2.5 \times 10^4 \text{ y} .$$