44. (a) We are given the energy release per fusion (calculated in §44-7: $Q = 26.7\,\text{MeV} = 4.28 \times 10^{-12}\,\text{J}$) and that four protons are consumed in each fusion event. To find how many sets of four protons are in the sample, we adapt Eq. 43-20:

$$N_{4p} = \frac{M_{\text{sam}}}{4M_H}\,N_{\text{A}} = \left(\frac{1000\,\text{g}}{4(1.0\,\text{g/mol})}\right)\left(6.02 \times 10^{23}/\text{mol}\right) = 1.5 \times 10^{26} \;.$$

Multiplying this by Q gives the total energy released: 6.4×10^{14} J. It is not required that the answer be in SI units; we could have used MeV throughout (in which case the answer is 4.0×10^{27} MeV).

(b) The number of ^{235}U nuclei is

$$N_{235} = \left(\frac{1000\,\text{g}}{235\,\text{g/mol}}\right)\left(6.02 \times 10^{23}/\text{mol}\right) = 2.56 \times 10^{24} \;.$$

If all the U-235 nuclei fission, the energy release (using the result of Eq. 44-6) is

$$N_{235}Q_{\text{fission}} = \left(2.56 \times 10^{22}\right)(200\,\text{MeV}) = 5.1 \times 10^{26}\,\text{MeV} = 8.2 \times 10^{13}\ \text{J} \;.$$

We see that the fusion process (with regard to a unit mass of fuel) produces a larger amount of energy (despite the fact that the Q value per event is smaller).