

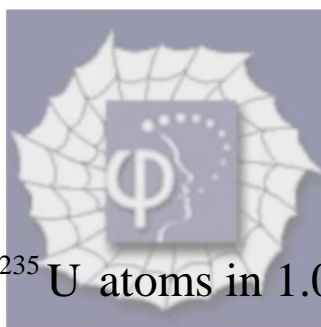
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**Problem 55.3 (RHK)**

*We have to answer the following:*

(a) *How many atoms are contained in 1.00 kg of pure  $^{235}\text{U}$ ? (b) How much energy, in joules, is produced by the complete fissioning of 1.00 kg of  $^{235}\text{U}$ ? We may assume  $Q = 200$  MeV. (c) For how many years would this energy light a 100-W lamp?*

**Solution:**



(a)

The number of  $^{235}\text{U}$  atoms in 1.00 kg of pure  $^{235}\text{U}$  will be

$$N = \frac{6.02 \times 10^{23} \times 10^3 \text{ g}}{235 \text{ g}} = 2.56 \times 10^{24}.$$

(b)

It is given that energy released by fission per  $^{235}\text{U}$  nucleus is 200 MeV. Therefore, the total energy, in joules, produced by complete fissioning of 1.00 kg of pure  $^{235}\text{U}$ , or  $2.56 \times 10^{24}$   $^{235}\text{U}$  atoms, will be

$$E = 2.56 \times 10^{24} \times 200 \times 1.6 \times 10^{-13} \text{ J}$$
$$= 8.197 \times 10^{13} \text{ J.}$$

(c)

The total time for which a light bulb of 100 W will glow with this energy will be

$$t = \frac{8.197 \times 10^{13} \text{ J}}{100 \text{ J s}^{-1}} = 8.197 \times 10^{11} \text{ s}$$
$$= \frac{8.197 \times 10^{11} \text{ s}}{3.156 \times 10^7 \text{ s/y}}$$
$$= 2.59 \times 10^4 \text{ y.}$$

