

Answer on Question #49600, Chemistry, Other

Task:

Plutonium-240 (Pu-240) is a byproduct of the nuclear reaction that takes place in a reactor. It takes one thousand years for 10.0% of a 4.60-g sample to decay.

A. What is the half-life of PU-240?

B. How long will it take to reduce a 2.00-g sample to 15% of its original amount?

C. What is the rate of decay of a 5.00-g sample in g/year?

Answer:

A. Half-life of an element is a period, during which a half amount of the element is decayed.

$$[Pu - 240] = 4,6 - 0,1 \cdot 4,6 = 4,14 \text{ g}$$

$$\ln 4,6 - \ln 4,14 = k(1000 \text{ y}) \quad k = 1,05 \cdot 10^{-4} \text{ y}^{-1}$$

$$t_{1/2} = \frac{0,693}{1,05 \cdot 10^{-4} \text{ y}^{-1}} = 6,6 \cdot 10^3 \text{ y}$$

B.

$$[Pu - 240] = 0,15 \cdot 2,00 = 0,30 \text{ g}$$

$$\ln 2,00 - \ln 0,30 = (1,05 \cdot 10^{-4} \text{ y}^{-1})t \quad t = 1,8 \cdot 10^4 \text{ y}^1$$

$$\text{C. Rate} = (1,05 \cdot 10^{-4} \text{ y}^{-1}) \cdot 5,00 = 5,25 \cdot 10^{-4} \text{ g / y}$$