Answer on Question #49454-Physics-Nuclear Physics

50V has one of the longest known radioactive half-lives. In a difficult experiment, a researcher found that the activity of 1.00 kg of 50V is 1.75 Bq. What is the half-life in years?

Solution

The activity R of a source is related to N and $t_{\frac{1}{2}}$ by

$$R = \frac{0.693N}{t_{\frac{1}{2}}}.$$

$$N = \frac{m}{m_0} = \frac{1.00 \text{ kg}}{\left(50 \cdot 1.66 \cdot 10^{-27} \frac{kg}{nucleos}\right)} = 0.012 \cdot 10^{27} nucleos.$$

The half-life is

$$t_{\frac{1}{2}} = \frac{0.693N}{R} = \frac{0.693 \cdot 0.012 \cdot 10^{27}}{1.75 \text{ s}^{-1}} = 4.752 \cdot 10^{24} s = \frac{4.752 \cdot 10^{24}}{31557600} \, years = 1.48 \cdot 10^{17} \, years.$$