- The half life of the radioactive isotope ^{16}N is 7.13 s. Calculate how long it takes to reduce the radioactivity of a given sample to 71.6% of the initial value.

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As the half life, $t_{1/2}$, is related to the decay constant, λ, by $t_{1/2} = \frac{\ln 2}{\lambda}$:

$$\lambda = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{7.13} = 0.0972 \text{ s}^{-1}$$

The number of radioactive nuclei, N_t, at time t is related to the initial number N_0 by $\ln \frac{N_0}{N_t} = \lambda t$. As the activity is directly proportional to the number of radioactive nuclei, the radioactivity will be 71.6% of its initial value when $\frac{N_t}{N_0} = 0.716$ or $\frac{N_0}{N_t} = \frac{1}{0.716}$. Hence,

$$\ln\left(\frac{1}{0.716}\right) = (0.0972)t \quad \text{and so } t = 3.44 \text{ s}$$

Answer: **3.44 s**