Question #63798, Chemistry / General Chemistry

The decay constant of Cobalt-60, a beta emitter, is 0.1307 years-1

- What is it's half-life?
- If 786 µCi of Cobalt-60 is found in your facility, what activity will remain 23 years later?

Solution*:*
Rate of decay can be described as:

$$N = N_0 e^{-kt}$$

N - amount of atoms left
N_0 – initial amount of atoms
k – the decay constant
t – time.
- What is it's half-life?

$$N = \frac{1}{2}N_0$$

$$\frac{N}{N_0} = e^{-kt}$$

$$\frac{\frac{1}{2}N_0}{N_0} = e^{-kt_{\frac{1}{2}}}$$

$$\frac{1}{2} = e^{-kt_{\frac{1}{2}}}$$

$$\ln\frac{1}{2} = -kt_{\frac{1}{2}}$$

$$\ln 2 = kt_{\frac{1}{2}}$$

$$t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{\ln 2}{0.1307 \text{ years}^{-1}} = \textbf{\textit{5.3 years}}$$

Half-life is 5.3 years.

$$N = 786\ \mu Ci \times e^{-0.1307 \times 23} = \textbf{38.9 } \boldsymbol{\mu Ci}$$