Example:

Radioactive radon-222 decays with a loss of one α particle.
$\frac{1}{2}$ life = 3.82 days. What % of radon in a sealed vial would remain after 7.0 days?

$$\boxed{\ln \frac{N_t}{N_0} = -kt = -\frac{\ln 2}{t_{1/2}} t = \frac{\ln(\frac{1}{2})}{t_{1/2}} t}$$

$$\ln \frac{N_t}{N_0} = \ln\left(\tfrac{1}{2}\right) \cdot \frac{t}{t_{1/2}}$$

$$\boxed{\frac{N_t}{N_0} = \left(\tfrac{1}{2}\right)^{t/t_{1/2}}} = (0.5)^{t/t_{1/2}}$$

$$\frac{N_t}{N_0} = \left(\frac{1}{2}\right)^{7.0d/3.82d} = \left(\frac{1}{2}\right)^{1.83} = 0.281 = 28.1\%$$

$t_{1/2} = 1$ $\frac{N_t}{N_0} = \frac{1}{2}$

t	$\frac{N_t}{N_0}$
1	$\frac{1}{2}$
2	$\left(\frac{1}{2}\right)^2 = \frac{1}{4}$
3	$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

Radiometric Dating

- the amount of 14C in atmosphere is relatively constant due to cosmic rays
- It is incorporated into living organisms
- After they die, 14C slowly decays according to its half-life
- The amount of 14C remaining can be used as a 'clock' to date the object

14C $t_{1/2}$ = 5730 yrs

14C Dating

A mammoth tusk containing grooves made by a sharp stone was uncovered at an ancient campsite in the Ural Mtns in 2001. The $^{14}C/^{12}C$ ratio in the tusk was only 1.19% of that in modern elephant tusks. How old is the mammoth tusk?

$$\ln \frac{N_t}{N_0} = -kt = -\frac{0.693}{t_{1/2}} t$$

$$-\ln(0.0119) \frac{t_{1/2}}{0.693} = t$$

$$-\ln(0.0119) \frac{5730 \text{ yrs}}{0.693} = t = 3.66 \times 10^4 \text{ yrs}$$