

Chemical Kinetics

1. What is a half-life?

This is the amount of time that it takes a sample to decrease to $\frac{1}{2}$ of its initial value. We will only be looking at nuclear decays in terms of being first order. The equation for a first order decay is:

$$t_{1/2} = \frac{\ln 2}{k} \quad \text{or} \quad \ln \left(\frac{N}{N_0} \right) = -kt$$

2. Bismuth-210 is radioactive and decays by β particle production and has a half-life of 5 days.

- a. How much of a 1.00-g sample of ^{210}Bi is left after 2 weeks?

$$t_{1/2} = 5 \text{ days} = 0.693 / k \rightarrow k = 0.1386 \text{ days}^{-1}$$

$$\ln N = - (0.1386 \text{ days}^{-1}) (14) + \ln (1) \rightarrow N = 0.14 \text{ g } ^{210} \text{ Bi}$$

- b. How long does it take for 75% of a sample of ^{210}Bi to decay?

$$\ln (0.25) = - (0.1386 \text{ days}^{-1})(t) + \ln(1.00) \rightarrow t = 10 \text{ days}$$