

growth  
 $y = ae^{kt}$

decay  
 $y = ae^{-kt}$

Using Exp and Log Functions

**SCIENCE** The half-life of a radioactive substance is the time it takes for half of the atoms of the substance to disintegrate. The half-life of Carbon-14 is 5730 years. Determine the value of  $k$  and the equation of decay for Carbon-14.

$$\frac{.5a}{a} = \frac{ae^{-k(5730)}}{a}$$

$$\ln .5 = \frac{-k(5730)}{1}$$

$$\frac{\ln .5}{-5730} = \frac{-5730k}{-5730}$$

$$k = .00012$$

**SCIENCE** A paleontologist examining the bones of a prehistoric animal estimates that they contain 2% as much Carbon-14 as they would have contained when the animal was alive.

a. How long ago did the animal live?

$$\ln .02 = \frac{-0.00012t}{1}$$

$$\frac{\ln .02}{-0.00012} = \frac{-0.00012t}{-0.00012}$$

$$t = 32400.19 \text{ yrs}$$

**1. PALEONTOLOGY** The half-life of Potassium-40 is about 1.25 billion years.

a. Determine the value of  $k$  and the equation of decay for Potassium-40.

$$\ln .5 = \frac{-k(1250000000)}{1}$$

$$\frac{\ln .5}{-125} = \frac{-1250000000k}{-125}$$

$$k = 5.545 \times 10^{-10}$$

- b. A specimen currently contains 36 milligrams of Potassium-40. How long will it take the specimen to decay to only 15 milligrams of Potassium-40?

$$\frac{15}{36} = \frac{36e^{-.000000005545t}}{36}$$

$$\ln .4167 = \ln e^{-.000000005545t}$$

$$\frac{\ln .4167}{-.5545} = \frac{-.000000005545t}{-.5545}$$

$$t = 1,578,699,262 \text{ yrs}$$

- c. How many milligrams of Potassium-40 will be left after 300 million years?

$$y = 36e^{-.000000005545(300,000,000)}$$

$$y = 30.48 \text{ mg}$$

- d. How long will it take Potassium-40 to decay to one eighth of its original amount?

$$\frac{1}{8}(36) = 36e^{-.000000005545t}$$

$$\frac{4.5}{36} = \frac{36e^{-.000000005545t}}{36}$$

$$\ln .125 = \ln e^{-.000000005545t}$$

$$\frac{\ln .125}{-.5545} = \frac{-.000000005545t}{-.5545}$$

$$t = 3,750,120,003 \text{ yrs}$$

- 7 PALEONTOLOGY A paleontologist finds a human bone and determines that the Carbon-14 found in the bone is 85% of that found in living bone tissue. How old is the bone?

$$\ln .85 = \ln e^{-.00012t}$$

$$\frac{\ln .85}{-.00012} = \frac{-.00012t}{-.00012}$$

$$t = 1354.32 \text{ yrs}$$