

Applications of e and ln

The formula $A = 37.3e^{0.0095t}$ models the population of California, A , in millions, t years after 2010.

- a. What was the population of California in 2010?
- b. When will the population of California reach 40 million?

The formula $A = 25.1e^{0.0187t}$ models the population of Texas, A , in millions, t years after 2010.

- a. What was the population of Texas in 2010?
- b. When will the population of Texas reach 28 million?

Use the formula $A = P\left(1 + \frac{r}{n}\right)^{nt}$ to complete the table below

Principal	Number of compoundings per year	Annual Interest Rate	Accumulated Amount	Time in Years
\$12,500	4	5.75%	\$20,000	
	12	6.5%	\$15,000	7
\$1000	365	16.8%	\$1400	
\$5000	52		\$9000	4

Use the formula $A = Pe^{rt}$ to complete the table below

Principal	Annual Interest Rate	Accumulated Amount	Time in Years
\$8000	8%	Double the amount invested	
\$8000	11.3%		5
\$2350		Triple the amount invested	10
	4.25%	\$25,000	7

The half-life of the radioactive element krypton-91 is 10 seconds. If 16 grams of krypton-91 are initially present, how many grams are present after 10 seconds? 20 seconds? 30 seconds? 40 seconds? 50 seconds?

The half-life of the radioactive element plutonium-239 is 25,000 years. If 16 grams of plutonium-239 are initially present, how many grams are present after 25,000 years? 50,000 years? 75,000 years? 100,000 years? 125,000 years?

Prehistoric cave paintings were discovered in a cave in France. The paint contained 15% of the original carbon-14. Estimate the age of the paintings.

Skeletons were found at a construction site in San Francisco in 1989. The skeletons contained 88% of the expected amount of carbon-14 found in a living person. In 1989, how old were the skeletons?

The half-life of aspirin in your bloodstream is 12 hours. How long will it take for the aspirin to decay to 70% of the original dosage?

Xanax is a tranquilizer used in the short-term relief of symptoms of anxiety. Its half-life in the bloodstream is 36 hours. How long will it take for Xanax to decay to 90% of the original dosage?

The logistic growth function

$$f(t) = \frac{100,000}{1 + 5000e^{-t}}$$

describes the number of people, $f(t)$, who have become ill with influenza t weeks after its initial outbreak in a particular community.

- a. How many people became ill with the flu when the epidemic began?
- b. How many people were ill by the end of the fourth week?
- c. What is the limiting size of the population that becomes ill?

We see from the calculator screen at the bottom of the previous page that a logistic growth model for world population, $f(x)$, in billions, x years after 1949 is

$$f(x) = \frac{12.57}{1 + 4.11e^{-0.026x}}$$

Use this function to solve Exercises 38–42.

38. How well does the function model the data showing a world population of 6.1 billion for 2000?
39. How well does the function model the data showing a world population of 6.9 billion for 2010?
40. When did world population reach 7 billion?
41. When will world population reach 8 billion?
42. According to the model, what is the limiting size of the population that Earth will eventually sustain?

The logistic growth function

$$P(x) = \frac{90}{1 + 271e^{-0.122x}}$$

models the percentage, $P(x)$, of Americans who are x years old with some coronary heart disease. Use the function to solve Exercises 43–46.

43. What percentage of 20-year-olds have some coronary heart disease?
44. What percentage of 80-year-olds have some coronary heart disease?
45. At what age is the percentage of some coronary heart disease 50%?
46. At what age is the percentage of some coronary heart disease 70%?