

Algebra 2 7.8

Use logarithms to solve problems involving exponential growth and decay

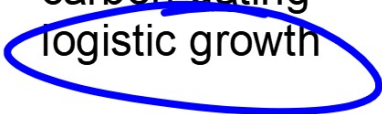
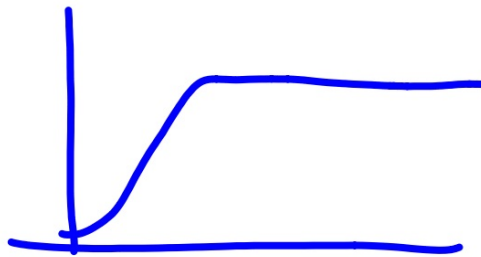
Use logarithms to solve problems of logistic growth

Calculate half-life

half-life

carbon dating

logistic growth



 **KeyConcept** Exponential Growth and Decay

Exponential Growth

Exponential growth can be modeled by the function

$$f(x) = ae^{kt}$$

where a is the initial value, t is time in years, and k is a constant representing the **rate of continuous growth**.

Exponential Decay

Exponential decay can be modeled by the function

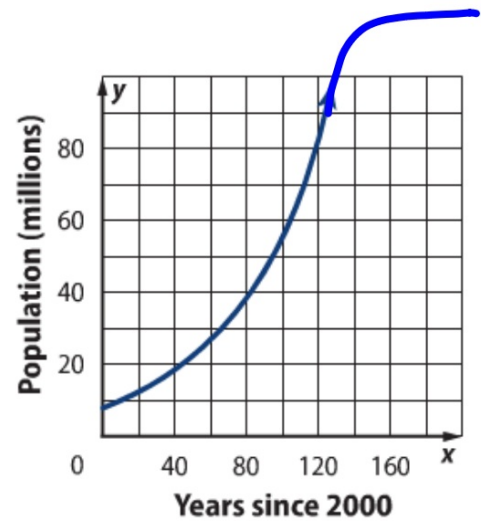
$$f(x) = ae^{-kt}$$

where a is the initial value, t is time in years, and k is a constant representing the **rate of continuous decay**.

2 Logistic Growth Refer to the equation representing Georgia's population in Example 3. According to the graph at the right, Georgia's population will be about one billion by the year 2130. Does this seem logical?

Populations cannot grow infinitely large. There are limitations, such as food supplies, war, living space, diseases, available resources, and so on.

Exponential growth is unrestricted, meaning it will increase without bound. A **logistic growth model**, however, represents growth that has a limiting factor. Logistic models are the most accurate models for representing population growth.



limiting factor...

 **KeyConcept** Logistic Growth Function

Let a , b , and c be positive constants where $b < 1$. The logistic growth function is represented

by $f(t) = \frac{c}{1 + ae^{-bt}}$, where t represents time.

Will give you this equation if needed

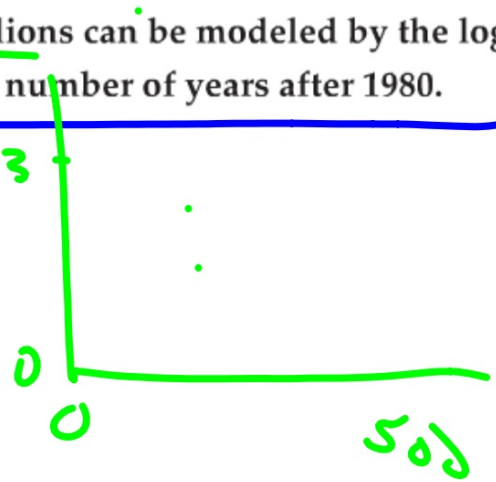
Graphing calculator (be careful with parentheses)



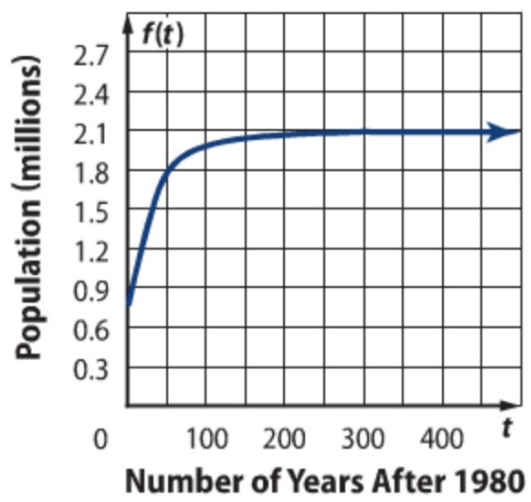
Real-World Example 4 Logistic Growth

The population of Phoenix, Arizona, in millions can be modeled by the logistic function $f(t) = \frac{2.0666}{1 + 1.66e^{-0.048t}}$ where t is the number of years after 1980.

- Graph the function for $0 \leq t \leq 500$.
- What is the horizontal asymptote?



better graph next page



c. Will the population of Phoenix increase indefinitely? If not, what will be their maximum population?

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d. According to the function, when will the population of Phoenix reach 1.8 million people?

Guided Practice

4. The population of a certain species of fish in a lake after t years can be modeled by the function $P(t) = \frac{1880}{1 + 1.42e^{-0.037t}}$, where $t \geq 0$.
- A. Graph the function for $0 \leq t \leq 500$.
 - B. What is the horizontal asymptote?
 - C. What is the maximum population of the fish in the lake?
 - D. When will the population reach 1875?

*
(-0.85, 0.43)
" (-0.70, 0.46)

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- b. If prior research points to the animal being around 20,000 years old, how much Carbon-14 should be in the animal?

StudyTip

Carbon Dating When given a percent or fraction of decay, use an original amount of 1 for a .

