

### 3.2 Exponential & Logistic Modeling

Target 3F: Model real world situations and use regressions with the use of functions

#### Review of Prior Concepts

The population of country A was 40 million in the year 2000 and has grown continually in the years following. The population  $P$ , in millions, of the country  $t$  years after 2000 can be modeled by the function  $P(t) = 40e^{0.027t}$ , where  $t \geq 0$ .

Based on the model, the solution to the equation  $50 = 40e^{0.027t}$  gives the number of years it will take for the population of country A to reach 50 million. What is the solution to the equation expressed as a logarithm?

#### More Practice

##### Introduction to Exponential Functions

<http://www.virtualnerd.com/algebra-2/exponential-logarithmic-functions/exponentials/exponential-functions/function-definition>

<https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/v/exponential-growth-functions>

<https://www.youtube.com/watch?v=jnOwrj8OvYI>

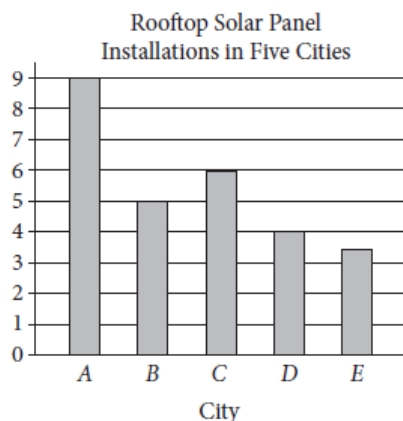


#### SAT Connection

##### Problem Solving and Data Analysis

5. Use the relationship between two variables to investigate key features of the graph.

Example:

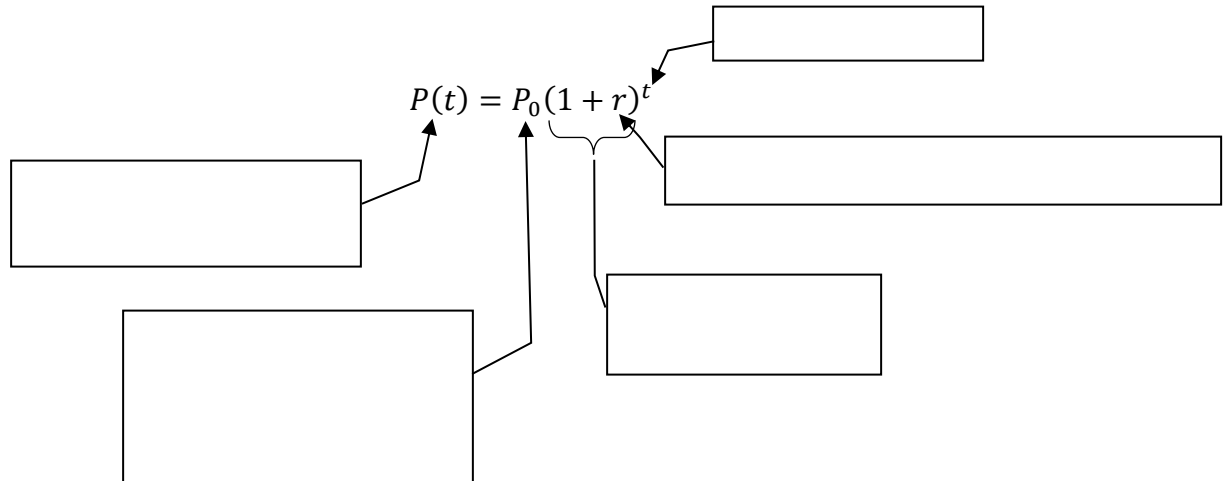


- A) Number of installations (in tens)
- B) Number of installations (in hundreds)
- C) Number of installations (in thousands)
- D) Number of installations (in tens of thousands)

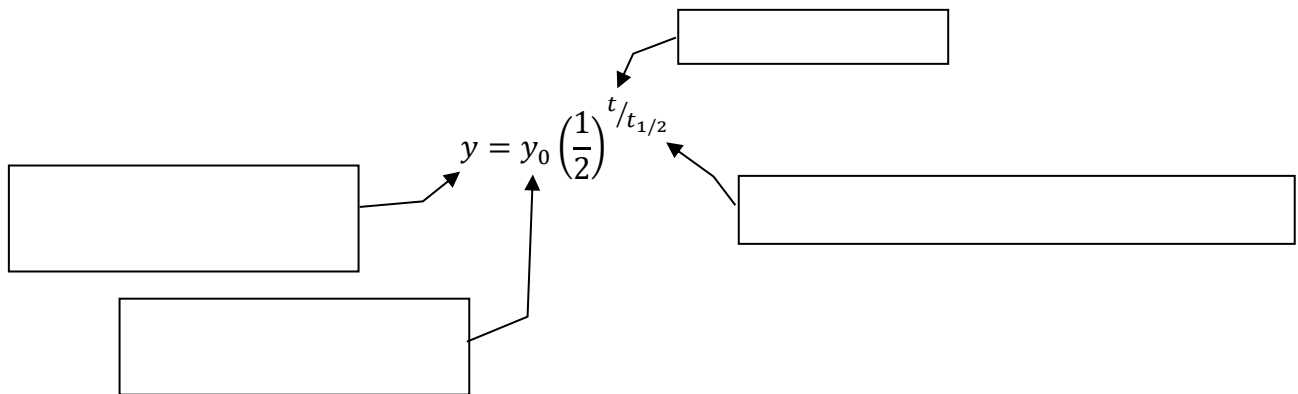
The number of rooftops with solar panel installations in 5 cities is shown in the graph above. If the total number of installations is 27,500, what is an appropriate label for the vertical axis of the graph?

Solution

**Exponential Population Model**



**Half-Life/Radioactive Decay Model**



*Example 1:*

Write the exponential function that satisfies the given conditions:

**a)** initial value = \$10,  
increasing at a rate of 3%  
per day

**b)** initial value = \$10,  
decreasing at a rate of 3%  
per day

**c)** initial population = 250,  
halving every 2 hours

*Example 2:*

The population of River City in the year 1910 was 4200. Assume the population increased at a rate of 2.25% per year.

- a) Estimate the population in 1930 and 1900.      b) Determine when the population reached 20,000.

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*Example 3:*

The half-life of a certain radioactive substance is 65 days. There are 3.5g present initially.

- a) Express the amount of substance remaining as a function of time  $t$ .      b) When will there be less than 1g remaining?

**More Practice**

**Exponential Population Models**

<http://www.mathsisfun.com/money/compound-interest.html>

<http://www.coolmath.com/algebra/17-exponentials-logarithms/03-compound-interest-01>

<https://youtu.be/m5Tf6vgoJtQ>

**Half-Life Models**

<http://www.coolmath.com/algebra/17-exponentials-logarithms/13-radioactive-decay-decibel-levels-01>

<https://youtu.be/kaxfCiP9d0w>

**Homework Assignment**

p.270 #1,3,12,18,19,29,33,39,43

**SAT Connection****Solution**

**Choice C is correct.** Let  $x$  represent the number of installations that each unit on the  $y$ -axis represents. Then  $9x$ ,  $5x$ ,  $6x$ ,  $4x$ , and  $3.5x$  are the number of rooftops with solar panel installations in cities A, B, C, D, and E, respectively. Since the total number of rooftops is 27,500, it follows that  $9x + 5x + 6x + 4x + 3.5x = 27,500$ , which simplifies to  $27.5x = 27,500$ . Thus,  $x = 1,000$ . Therefore, an appropriate label for the  $y$ -axis is “Number of installations (in thousands).”

Choices A, B, and D are incorrect and may result from errors when setting up and calculating the units for the  $y$ -axis.