

Exponential and Logarithmic Function Word Problems

Goal:

- to solve word problems using exponential and logarithmic functions

The population of a town is given by the rule

$$P(x) = 250000e^{0.012x}$$

where x is the number of years since 2012.

a) What will the population be in 2020?

In 2020, $x = 8$

$$P(8) = 250000e^{0.012(8)}$$

$$= 275189.766$$

$$\approx 275190$$

b) What is the rule that describes the time since 2012 as a function of the town's population?

$$P(x) = 250000e^{0.012x}$$

population as function of time

$$\frac{P(x)}{250000} = e^{0.012x}$$

$\log_{\text{base}}(\text{result}) = \text{exponent}$

$$\log_e\left(\frac{P(x)}{250000}\right) = 0.012x$$

$\log_e = \ln$

$$x = \frac{1}{0.012} \ln\left(\frac{P(x)}{250000}\right)$$

$$x = \frac{250}{3} \ln\left(\frac{P(x)}{250000}\right)$$

c) When will the population of the town reach 400 000?

$$x = \frac{250}{3} \ln\left(\frac{400000}{250000}\right)$$

get familiar with your calculator

$$= 39.2$$

$$2012 + 39.2 = 2051$$

In 2051.

To evaluate logs:

$$\log_c m = \frac{\log m}{\log c} = \frac{\ln m}{\ln c} = \frac{\log_n m}{\log_n c}$$

CHANGE OF BASE

Ex:

a) $\log_2 8 = 3$

$$\frac{\log 8}{\log 2} = \frac{\ln 8}{\ln 2} = 3$$

b) $\log_4 20$

$$= \frac{\ln 20}{\ln 4} = 2.16$$

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