HAT
Applications of Continuous Growth/Decay

12/7/17

Warm Up:

An exponential growth model that approximates the world population (in millions) is

$$P = 5400e^{0.011852t}$$

where t = 8 represents 1998. According to this model, when will the world population reach 6.8 billion?

6.8 billion $\boxed{6,800,000,000}$

6800 million

$P = 5400e^{.011852(27)}$

$P = 7436.52$

$\frac{6800}{5400} = \frac{5400e^{.011852t}}{5400}$

$\ln \frac{34}{27} = \ln e^{.011852t}$

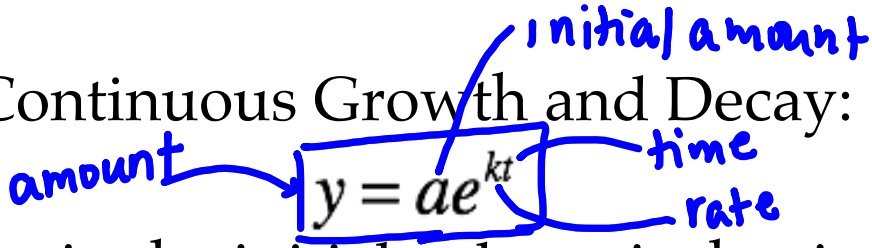
$\frac{\ln(34/27)}{.011852} = \frac{.011852t}{.011852}$

$19.450 = t$

year

2009

Continuous Growth and Decay:



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

Same as $A = Pe^{rt}$

Ex#1:

The population of St. Charles County in 2000 was estimated at 283,883 residents. In 2010 the population was estimated at 360,485. If the population growth is continuous, write an equation to model this situation.

$$y = ae^{kt}$$

$$\frac{360,485}{283,883} = \frac{283,883\,e^{k(10)}}{283,883}$$

$$\ln\left(\frac{360,485}{283,883}\right) = \ln e^{10\cdot k}$$

$$\frac{\ln\left(\frac{360485}{283883}\right)}{10} = \frac{10k}{10}$$

$k = 0.023889$

round to 6 decimal places

$$y = ae^{0.023889\cdot t}$$

Ex#2:

Andrew is at the doctor for a bone scan. The procedure involves injecting 10 mL of a radioactive isotope before an x-ray is taken. If the isotope has a half-life of 6 hours, write an exponential equation that models this situation.

$y = ae^{kt}$

$5 = 10e^{k(6)}$

$\frac{1}{2} = e^{6k}$

$\frac{\ln\frac{1}{2}}{6} = \frac{6k}{6}$

$-0.115525 = k$

$y = 10e^{-0.115525t}$

t = hours

either one works!

$y = 10\left(\frac{1}{2}\right)^{t/6}$

Algebraically determine how long it will take for the amount of the isotope in his system to fall below 1 mL.

$10e^{-0.115525t} < 1$

$\ln e^{-0.115525t} < \ln\frac{1}{10}$

$\frac{-0.115525 \cdot t}{-0.115525} < \frac{\ln(\frac{1}{10})}{-0.115525}$

$t > 19.931$ hours

** Checked on Tuesday!**

Assignment from Wednesday:

pg. 505 #29, 30, 35, 38, 39, 44, 45, 46, 55, 58

Tonight's Assignment:

page 513 #2, 7, 8, 9, 10, 11

Half life of Carbon^{14} = 5730

Assignment for Friday:

pg. 513 #6, 12, 15, 16

Ex#3:

The half-life of Carbon-14 is 5730 years. Find the equation for continuous decay for Carbon-14.

You will need this equation for your homework.....

Ex#4:

A specimen that originally contained 42 milligrams of Carbon-14 now contains 8 milligrams. How old is the fossil?

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