Warm Up:

Solve for x

$12 = 2^x$

3.13 Natural Logarithmic Functions

You invest $1,000 in a savings account earning 5% APR. How many years will go by before your amount doubles given that it is compounded continuously?

Hide formula

$2000 = 1000 \cdot e^{.05 \cdot t}$

$2 = e^{.05 \cdot t}$

Hide Answer

t = 13.86 years

Hide Step#1

$\log_e 2 = \log_e e^{.05 \cdot t}$

Hide Step#2

$$\frac{\log 2}{\log e} = .05t$$

A savings account compounded continuously doubles in a year. What is the rate?

Assign random values

$2 = 1e^{.r \cdot 1}$

$2 = e^{.r}$

Hide Step#1

$\log_e 2 = \log_e e^r$

Hide Step#2

$\frac{\log 2}{\log e} = r$

BIG IDEA #1

Notice that the rate is not equal to 100% due to compounding

Big #2

Equations dealing with the value e are very common. To speed the process of solving these equations, a $\log_e$ button was developed on your calculator called Natural log (ln)

$\log_e(x) = \ln(x)$

What are some examples of exponential growth or decay besides interest?

Hide Examples

Population growth
Bacteria
Carbon Dating--half life

E-coli divide every 20 minutes. If you start with 1 single ecoli bacterium how many hours will it take for the ecoli to divide into 1 million ecoli?

FIND r

$2 = 1e^{r \cdot 20}$

$2 = e^{20r}$

$\ln 2 = 20r$

$r \approx .0347$

Solve for t

$1000000 = 1e^{.0347 \cdot t}$

$\ln 1000000 = .0347t$

$t \approx 398.6$ minutes

6.64 h