The Number *e*

Section 8.3

Investigating the Natural Base

- Copy and complete the table. Use a calculator. Round to the nearest thousandth

n	10^1	10^2	10^3	10^4	10^5	10^6
$\left(1+\frac{1}{n}\right)^n$	$(1+\frac{1}{10})^{10}$ 2.594	$(1+\frac{1}{100})^{100}$ 2.705	2.717	2.718	2.718	2.718

- The natural base, *e,* is irational. It is defined as:

As *n* approaches $+\infty$, $\left(1+\frac{1}{n}\right)^n$ approaches *e,* 2.718281828459…

Simplify the expressions

- $e^3 \cdot e^4$ $= e^7$
- $\frac{10e^3}{5e^2}$ $= 2e$
- $(3e^{-4x})^2$ $= 3^2 e^{-4x \cdot 2}$ $= 9e^{-8x}$ $= \frac{9}{e^{8x}}$
- $\sqrt[3]{27e^{6x}}$ $= 3e^{2x}$

  $(27e^{6x})^{1/3}$

  $27^{1/3} e^{6x \cdot 1/3}$

  $3e^{2x}$

Evaluating and Graphing

Use a calculator to evaluate the expressions:

a.) e^2 = 7.389

b.) $e^{-0.06}$ = 0.942

Graph the Natural Base Functions

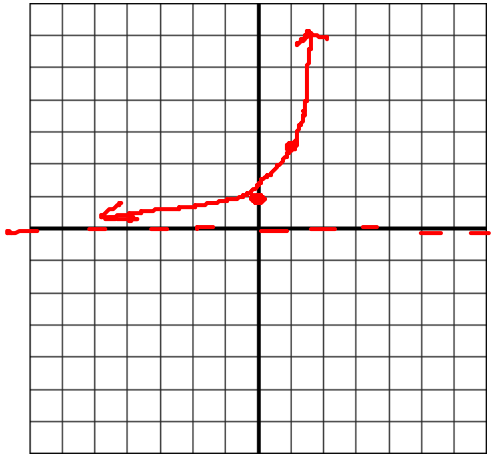
a.) $y = e^x$

(0, 1)

(1, 2.718)

exp. growth

HA: y = 0



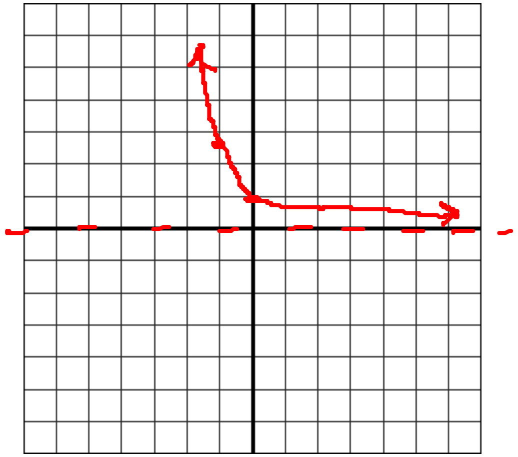
b.) $y = e^{-x}$

(0, 1)

(-1, 2.718)

exp. decay

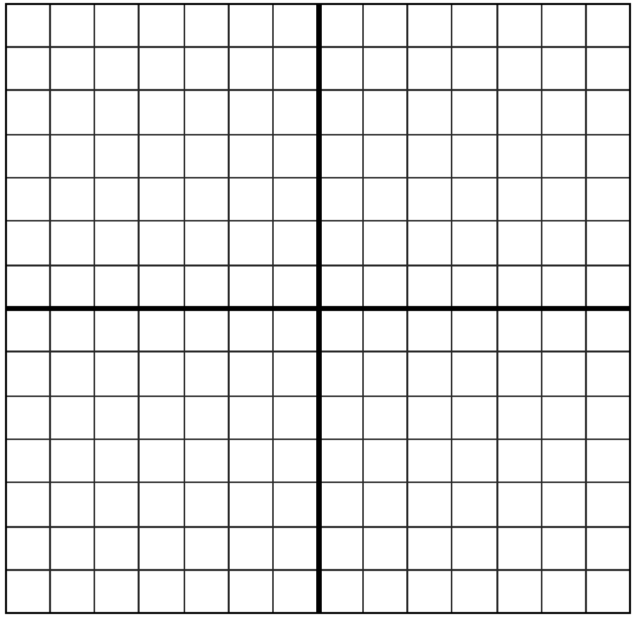
HA: y = 0



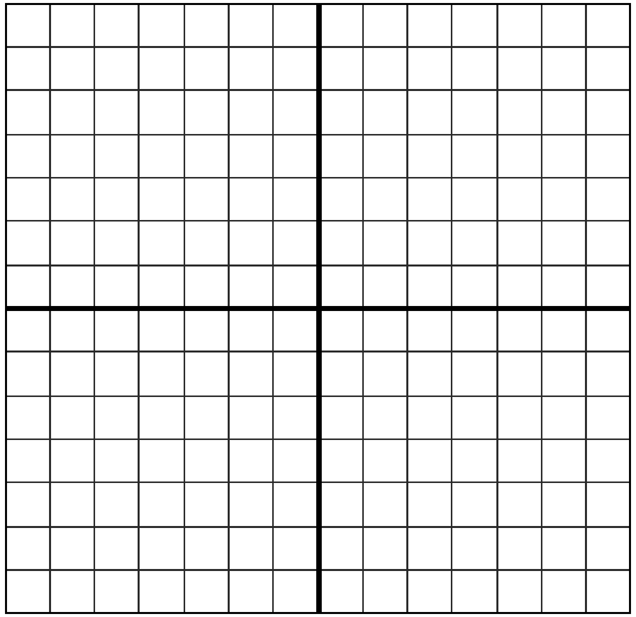
Graph the Natural Base Functions

- List Parent Graph
- Plot 2 points
- List/draw HA
- State D and R

- $y = 2e^{0.75x}$



- $y = e^{-0.5(x-2)} + 1$



Applications of *e*

- Formula for Interest compounded ***continuously***

$$A = Pe^{rt}$$

You deposit $1000 in an account that pays 8% annual interest compounded continuously. What is the balance after ~~2~~ 1 years?

$A = 1000e^{.08(1)}$

$A = \$1083.28$

Bank Accounts

You have \$25,000 to invest into a savings account. How much more money would you have after 50 years of compounding continuously with a rate of 3.5% than if you were to invest in an account compounded daily at the same rate over the same amount of time?

Continuously

$A = Pe^{rt}$

$A = 25{,}000\, e^{.035(50)}$

$A = \$143{,}865.06$

↳ Balance of the account

Interest $= 143{,}865.06 - 25{,}000$

$= \$118{,}865.06$

Daily

$A = P\left(1 + \frac{r}{n}\right)^{nt}$

$A = 25000\left(1 + \frac{.035}{365}\right)^{365 \cdot 50}$

$A = \$143{,}852.99$

$$\begin{array}{r} 143{,}865.06 \\ -\ 143{,}852.99 \\ \hline \end{array}$$

Difference is: \$12.07

Using Exponential Models

Since 1972 the U.S. Fish and Wildlife Service has kept a list of endangered species in the United States. For the years 1972 – 1998, the number *s* of species on the list can modelled by:

$$s = 119.6e^{0.0917t}$$

where *t* is the number of years since 1972.

a) What was the number of endangered species in 1972? 119.6 (≈ 120 endangered species)

b) Graph the model.

c) Use the graph to estimate when the number of endangered species reached 1000.

Textbook Practice Problems

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- 22 – 32 evens
- 49 – 60 all
- 61 – 66 matching
- 70, 73, 74 – graphing (use GC)
- 76, 79, 80 – apps