

Chapter 6  
Exponential and Logarithmic Functions

Section 6-2  
The Natural Base  $e$

 **Core Concept**

**The Natural Base  $e$**

The natural base  $e$  is irrational. It is defined as follows:

As  $x$  approaches  $+\infty$ ,  $\left(1 + \frac{1}{x}\right)^x$  approaches  $e \approx 2.71828182846$ .

**EXAMPLE 1** Simplifying Natural Base Expressions

Simplify each expression.

a.  $e^3 \cdot e^6$

b.  $\frac{16e^5}{4e^4}$

c.  $(3e^{-4x})^2$

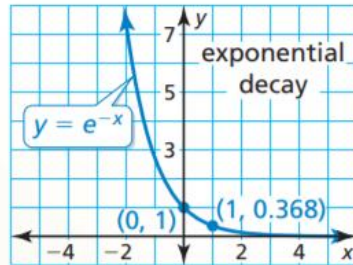
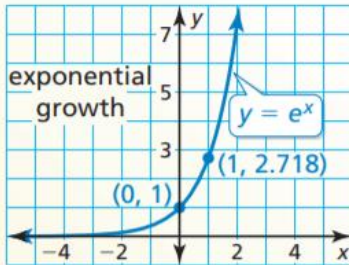
# Core Concept

## Natural Base Functions

A function of the form  $y = ae^{rx}$  is called a *natural base exponential function*.

- When  $a > 0$  and  $r > 0$ , the function is an exponential growth function.
- When  $a > 0$  and  $r < 0$ , the function is an exponential decay function.

The graphs of the basic functions  $y = e^x$  and  $y = e^{-x}$  are shown.

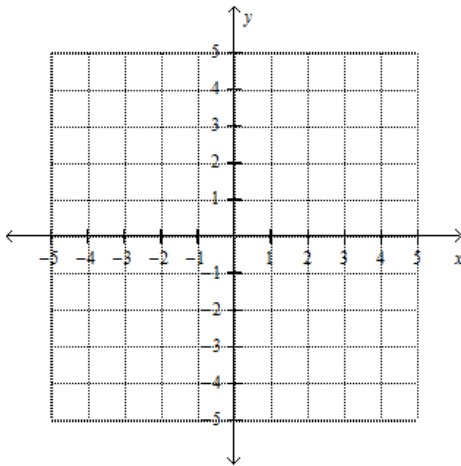


## EXAMPLE 2 Graphing Natural Base Functions

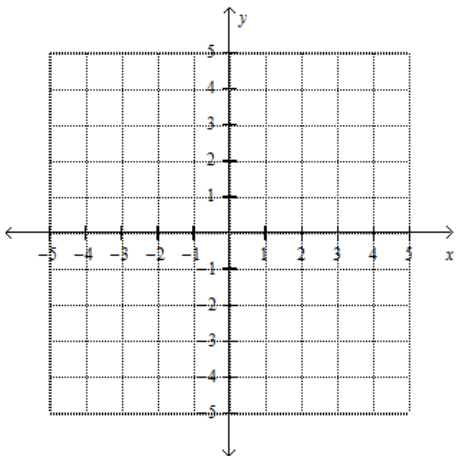
Tell whether each function represents *exponential growth* or *exponential decay*. Then graph the function.

a.  $y = 3e^x$

b.  $f(x) = e^{-0.5x}$



X	Y



X	Y

## Solving Real-Life Problems

You have learned that the balance of an account earning compound interest is given by

$A = P\left(1 + \frac{r}{n}\right)^{nt}$ . As the frequency  $n$  of compounding approaches positive infinity, the

compound interest formula approximates the following formula.

### Core Concept

#### Continuously Compounded Interest

When interest is compounded *continuously*, the amount  $A$  in an account after  $t$  years is given by the formula

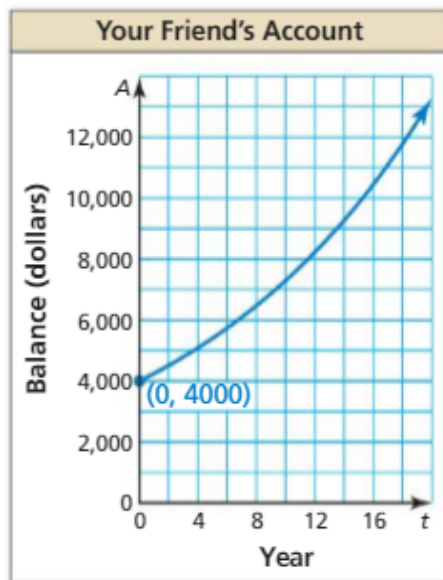
$$A = Pe^{rt}$$

where  $P$  is the principal and  $r$  is the annual interest rate expressed as a decimal.



#### EXAMPLE 3

#### Modeling with Mathematics



You and your friend each have accounts that earn annual interest compounded continuously. The balance  $A$  (in dollars) of your account after  $t$  years can be modeled by  $A = 4500e^{0.04t}$ . The graph shows the balance of your friend's account over time. Which account has a greater principal? Which has a greater balance after 10 years?