Lesson 8.1: Exponential Growth

Exponential function:

$y = ab^x$ OR $y = a(1 + r)^t$

a =

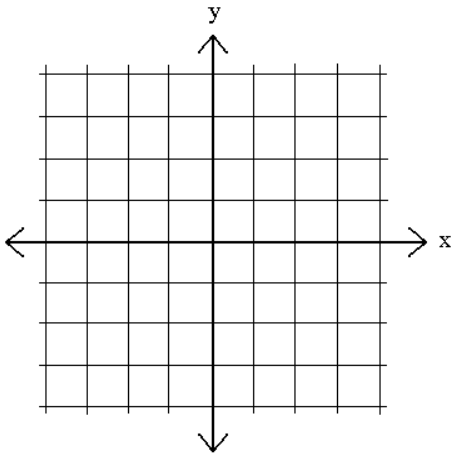
b or $(1 + r)$ =

x or t =

Example 1: Graph $y = 3^x$

x	y

**



Domain: _____

Range: _____

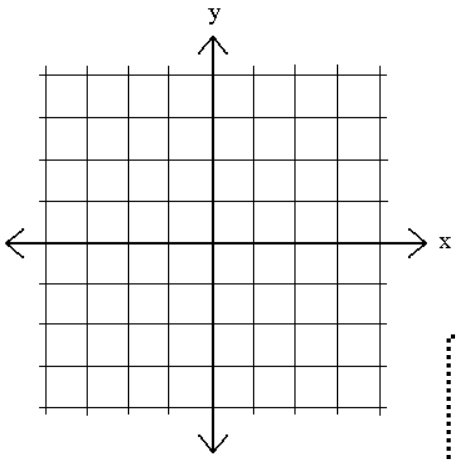
** Exponential growth if

_____ & _____

Notice the _____ is an **asymptote**: a line the graph approaches but does not cross.

Example 2: Graph $y = -3^x$

x	y



Domain: _____

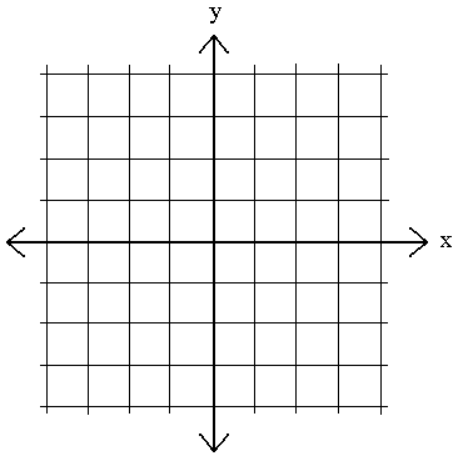
Range: _____

** Exponential growth? _____

because _____

Example 3: Graph $y = 2 \cdot 3^x$

x	y

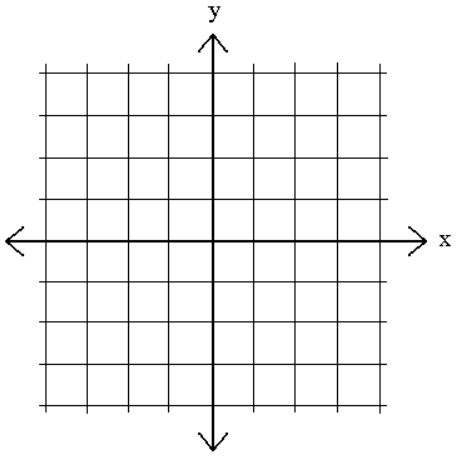


Domain: _____

Range: _____

Example 4: Graph $y = 2 \cdot 3^{x-2} + 1$

x	y



Domain: _____

Range: _____

Asymptote at _____

Example 5: In 1980 about 2,180,000 people worked from home. Over the next 10 years the number of people working from home increase 5% per year.

a) Write a model giving the number of workers (w) working at home t years after 1980.

b) Using your model estimate the number of people working from home in 2010.

Compound Interest: Interest paid on the original investment (principal) and on the previously earned interest.

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

P =

r =

t =

n =

Example 6: You deposit $1500 in an account that pays 6% annual interest. Find the balance after 1 year if the interest is compounded…

a. annually

b. semi-annually

c. quarterly

Lesson 8.2: Exponential Decay

Recall:

Exponential growth: $y = a(1 + r)^t$ ** where $a > 0$ and $b > 1$

Exponential decay: $y = a(1 - r)^t$ ** where $a > 0$ and $0 < b < 1$

a =

r =

t =

Example 1: State whether $f(x)$ is exponential growth or decay

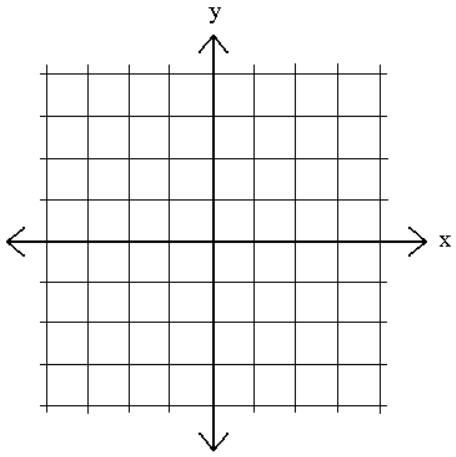
a. $f(x) = \frac{1}{3}(2)^{-x}$

b. $f(x) = 4\left(\frac{5}{8}\right)^x$

c. $f(x) = 8\left(\frac{5}{2}\right)^x$

Example 2: Graph $f(x) = 2\left(\frac{1}{2}\right)^x$

x	y

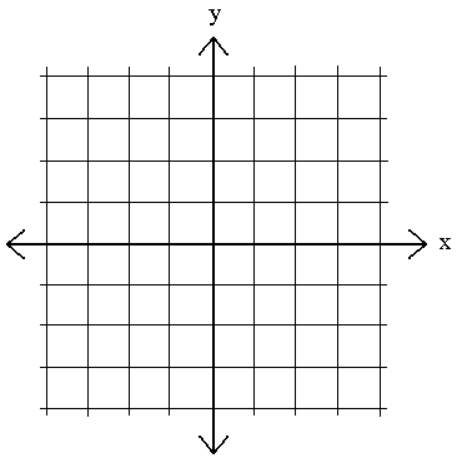


Domain: _____

Range: _____

Example 3: Graph $f(x) = 2\left(\frac{1}{2}\right)^{x-1} - 3$

x	y



Domain: _____

Range: _____

Example 4: You buy a new car for $28,000. The value y of the car decreases by 16% each year.

a. Write an exponential decay model for the value of the car.

b. Estimate the value after 2 years.

c. After 10 years?

Lesson 8.3: The Number "e"

The Number "e": is called the natural base or the Euler number after its discoverer Leonhard Euler.

Notice: given $x = \left(1 + \frac{1}{n}\right)^n$

a. Let $n = 10$ $x = 2.594$
b. Let $n = 100$ $x = 2.705$
c. Let $n = 1000$ $x = 2.717$
d. Let $n = 10{,}000$ $x = 2.718$
e. Let $n = 100{,}000$ $x = 2.718$
f. Let $n = 1{,}000{,}000$ $x = 2.718$

The values are approaching a fixed decimal number 2.718…

The Natural Base e: The natural base e is irrational and defined as follows:

$$e \approx 2.718281828459$$

Example 1: Use a calculator to evaluate the expression. Round to three decimal places.

$e^1 =$
$e^2 =$

Example 2: Simplify

a. $e^3 \cdot e^4$ b. $\frac{10e^3}{5e^2}$ c. $(3e^{-4x})^2$

Natural Base Functions: exponential functions of the form $f(x) = ae^{rx}$.

If a > 0 and r > 0 then it represents exponential growth. If a > 0 and r < 0 it represents exponential decay.

Example 3: Tell whether each is example of exponential growth or decay.

a. $f(x) = \frac{1}{8}e^{5x}$

b. $f(x) = e^{-8x}$

Continuously Compounded Interest: If interest is compounded continuously we use the formula…

$$A = Pe^{rt}$$

P =

r =

t =

Example 4: You deposit $1500 in an account that pays 7.5% annual interest confounded continuously. What is the balance after 1 year?