Name _____ Date _____

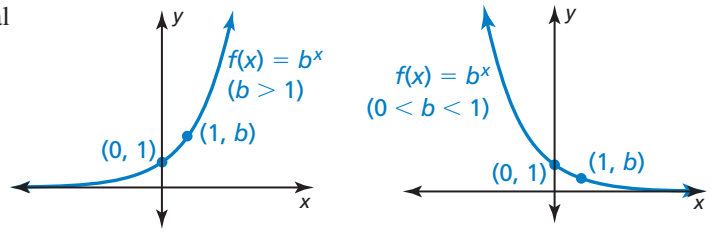
Exponential Functions

Graphing Exponential Functions

An **exponential function** is a nonlinear function of the form $y = ab^x$, where $a \neq 0$, $b \neq 1$, and $b > 0$.

- When $a > 0$ and $b > 1$, the function is an exponential growth function.
- When $a > 0$ and $0 < b < 1$, the function is an exponential decay function.

The graphs of the parent exponential functions $y = b^x$ are shown.

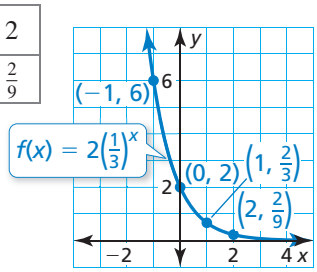


Example 1 **Tell whether each function represents *exponential growth* or *exponential decay*. Then graph the function.**

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

Because $a = 2$ is positive and $b = \frac{1}{3}$ is greater than 0 and less than 1, the function is an exponential decay function. Use a table to graph the function.

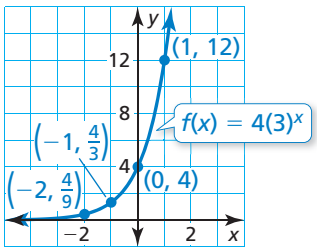
x	-1	0	1	2
y	6	2	$\frac{2}{3}$	$\frac{2}{9}$



b. $f(x) = 4(3)^x$

Because $a = 4$ is positive and $b = 3$ is greater than 1, the function is an exponential growth function. Use a table to graph the function.

x	-2	-1	0	1
y	$\frac{4}{9}$	$\frac{4}{3}$	4	12



Practice

Check your answers at BigIdeasMath.com.

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

1. $f(x) = \left(\frac{1}{4}\right)^x$

2. $f(x) = \left(\frac{4}{3}\right)^x$

3. $f(x) = 0.5(4)^x$

4. $f(x) = 3(0.75)^x$

5. $f(x) = 2(0.8)^x$

6. $f(x) = 5(2)^x$

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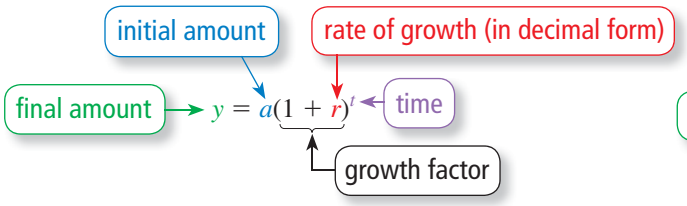
Exponential Functions

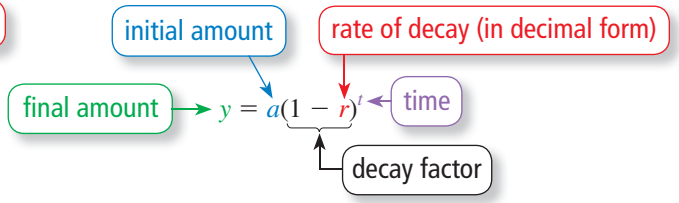
Rewriting Exponential Functions

Exponential growth occurs when a quantity increases by the same factor over equal intervals of time, whereas **exponential decay** occurs when a quantity decreases by the same factor over equal intervals of time.

Exponential Growth Model



Exponential Decay Model



Example 1 **Rewrite the function $y = 120(1.25)^{t/12}$ to determine whether it represents *exponential growth* or *exponential decay*. Then find the percent rate of change.**

$y = 120(1.25)^{t/12}$ Write the function.

$= 120[(1.25)^{1/12}]^t$ Power of a Power Property

$\approx 120(1.02)^t$ Evaluate the power.

$= 120(1 + 0.02)^t$ Rewrite in the form $y = a(1 + r)^t$.

▶ So, the function represents exponential growth and the growth rate is about 0.02, or 2%.

Practice

Check your answers at BigIdeasMath.com.

Rewrite the function to determine whether it represents *exponential growth* or *exponential decay*. Then find the percent rate of change.

1. $y = 80(0.85)^{2t}$
2. $y = 67(1.13)^{t/4}$
3. $y = 5\left(\frac{3}{2}\right)^{-8t}$
4. $y = 17\left(\frac{2}{5}\right)^{0.65t}$
5. $y = 4(0.5)^{t/88}$
6. $y = 31(1.02)^{4t}$
7. $y = 9(1.12)^{0.3t}$
8. $y = 750(0.88)^{t/3}$
9. $y = (0.64)^{5t}$
10. $y = 6(0.82)^{-0.25t}$

