Name_____ Class_____ Date_____

Lesson 8-1

Exploring Exponential Models

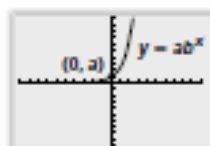| Lesson Objectives	NAEP 2005 Strand: Algebra
▼ Modeling exponential growth	Topic: Algebraic Representation
▼ Modeling exponential decay	Local Standards: _____

Vocabulary

An exponential function is _a function with the general form $y = ab^x$ where x is a real number,_
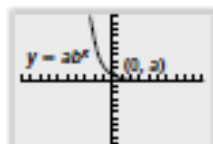_$a \neq 0$, and $b \neq 1$._

The growth factor is _b in an exponential growth function of the_
form $y = ab^x$ when $b > 1$.

Exponential Growth

$y = ab^x$
$(0, a)$

Growth factor $b > 1$

Exponential Decay

$y = ab^x$ $(0, a)$

Decay factor $0 < b < 1$

The decay factor is _b in an exponential_
decay function of the form $y = ab^x$ when
_$0 < b < 1$._

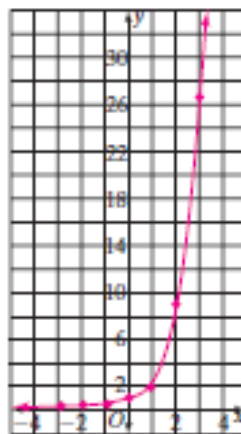An asymptote is _a line that a graph approaches as x or y increases_
in absolute value.

Examples

❶ **Graphing Exponential Growth** Graph $y = 3^x$.

Step 1 Make a table of values.

x	3^x		y
−3	3^{-3}	$\frac{1}{27} =$	.037
−2	3^{-2}	$\frac{1}{9} =$	.1
−1	3^{-1}	$\frac{1}{3} =$	.3
0	3^0		1
1	3^1		3
2	3^2		9
3	3^3		27

Step 2 Graph the coordinates.
Connect the points with a smooth curve.

② Writing an Exponential Function Write an exponential function $y = ab^x$ for a graph that includes $(1, 6)$ and $(0, 2)$.

$y = ab^x$	Use the general term.
$\boxed{6} = ab^{\boxed{1}}$	Substitute for x and y using $(1, 6)$.
$\dfrac{\boxed{6}}{b} = a$	Solve for a.
$\boxed{2} = \dfrac{\boxed{6}}{b} b^{\boxed{0}}$	Substitute for x and y using $(0, 2)$ and for a using $\dfrac{\boxed{6}}{b}$.
$\boxed{2} = \dfrac{\boxed{6}}{b} \cdot \boxed{1}$	Any nonzero number to the zero power equals $\boxed{1}$.
$b = \boxed{3}$	Solve for b.
$a = \dfrac{6}{b} = \dfrac{6}{\boxed{3}} = \boxed{2}$	Use your equation for a, substitute 3 for b, and simplify.
$y = \boxed{2} \cdot \boxed{3}^x$	Substitute $\boxed{2}$ for a and $\boxed{3}$ for b in $y = ab^x$.

The exponential function for a graph that includes $(1, 6)$ an $(0, 2)$ is
$$y = \boxed{ 2 \cdot 3^x }.$$

Quick Check

1. Graph the function $y = 4(2)^x$.

2. Write an exponential function $y = ab^x$ for a graph that includes $(2, 4)$ and $(3, 16)$.

$y = 0.25(4)^x$
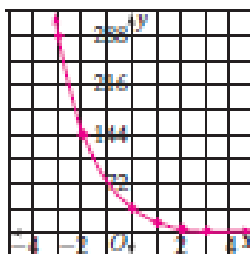
Example

⑤ Graphing Exponential Decay Graph $y = 36(0.5)^x$. Identify the horizontal asymptote.

Step 1 Make a table of values.

x	y
−3	288
−2	144
−1	72
0	36
1	18
2	9
3	$4\frac{1}{2}$

Step 2 Graph the coordinates. Connect the points with a smooth curve.

As x increases, y approaches ☐0☐.

The horizontal asymptote is the ☐x☐-axis, $y = $ ☐0☐.

Quick Check

3. Without graphing, determine whether each function represents exponential growth or exponential decay.

a. $y = 100(0.12)^x$
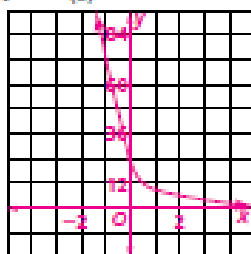
exponential decay

b. $y = 0.2(5)^x$

exponential growth

c. $y = 16\left(\frac{1}{2}\right)^x$
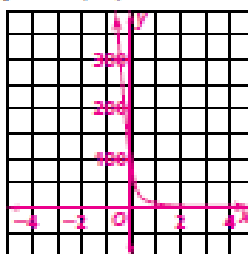
exponential decay

Graph each decay function. Identify the horizontal asymptote.

d. $y = 24\left(\frac{1}{3}\right)^x$

$y = 0$

e. $y = 100(0.1)^x$

$y = 0$