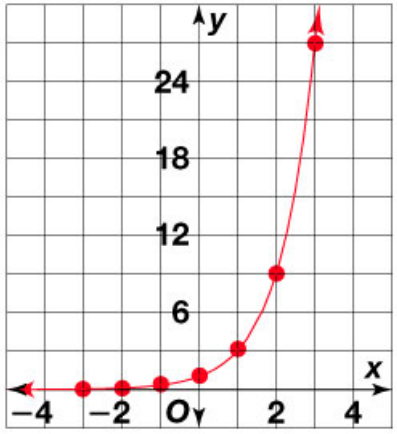
OBJECTIVE 1

1 EXAMPLE Graph $y = 3^x$.

Step 1: Make a table of values.

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



OBJECTIVE 1

2 EXAMPLE The population of the United States in 1994 was almost 260 million with an average annual rate of increase of about 0.7%.

a. Find the growth factor for that year.

$b = 1 + r$
$= 1 + 0.007$ Substitute 0.7%, or 0.007 for r.
$= 1.007$ Simplify.

b. Suppose the rate of growth had continued to be 0.7%. Write a function to model this population growth.

Relate: The population increases exponentially, so $y = ab^x$
Define: Let x = number of years after 1994.
Let y = the population (in millions).

OBJECTIVE 1

2 EXAMPLE (continued)

Write: $y = a(1.007)^x$

$260 = a(1.007)^0$ To find a, substitute the 1994 values: $y = 260$, $x = 0$.

$260 = a \cdot 1$ Any number to the zero power equals 1.

$260 = a$ Simplify.

$y = 260(1.007)^x$ Substitute a and b into $y = ab^x$.

$y = 260(1.007)^x$ models U.S. population growth.

OBJECTIVE 1

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

$y = ab^x$	Use the general term.
$6 = ab^1$	Substitute for x and y using (1, 6).
$\frac{6}{b} = a$	Solve for a.
$2 = \frac{6}{b}b^0$	Substitute for x and y using (0, 2) and for a using $\frac{6}{b}$.
$2 = \frac{6}{b} \cdot 1$	Any number to the zero power equals 1.
$2 = \frac{6}{b}$	Simplify.
$b = 3$	Solve for b.

OBJECTIVE 1

3 EXAMPLE (continued)

$a = \frac{6}{b}$	Use your equation for a.
$a = \frac{6}{3}$	Substitute 3 for b.
$a = 2$	Simplify.
$y = 2 \cdot 3^x$	Substitute 2 for a and 3 for b in $y = ab^x$.

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

OBJECTIVE 2

4 EXAMPLE Without graphing, determine whether the function $y = 3\left(\frac{2}{3}\right)^x$ represents exponential growth or decay.

In $y = 3\left(\frac{2}{3}\right)^x$, $b = \frac{2}{3}$.

Since $b < 1$, the function represents exponential decay.

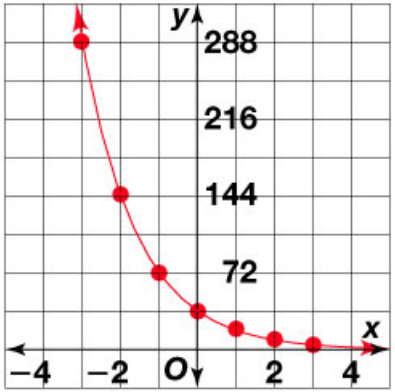
OBJECTIVE 2

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

Step 1: Make a table of values.

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

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, $y = 0$.

OBJECTIVE 2

6 EXAMPLE Suppose you want to buy a used car that costs $11,800. The expected depreciation of the car is 20% per year. Estimate the depreciated value of the car after 6 years.

The decay factor $b = 1 + r$, where r is the annual rate of change.

$b = 1 + r$ Use r to find b.

$= 1 + (-0.20) = 0.80$ Simplify.

Write an equation, and then evaluate it for $x = 6$.

Relate: The value of the car decreases exponentially; $b = 0.8$.

Define: Let x = number of years. Let y = value of the car.

OBJECTIVE 2

6 EXAMPLE (continued)

Write: $y = ab^x$

$11{,}800 = a(0.8)^0$ Substitute using (0, 11,800).

$11{,}800 = a$ Solve for a.

$y = 11{,}800(0.8)^x$ Substitute a and b into $y = ab^x$.

$y = 11{,}800(0.8)^6$ Evaluate for $x = 6$.

$\approx 3{,}090$ Simplify.

The car's depreciated value after 6 years will be about $3,090.