6.4 Exponential Growth & Decay DAY ONE

Essential Question:

What are some of the characteristics of exponential growth and exponential decay functions?

1) Growing Exponentially - you start with \$300 in your savings account. You earn 1.5% in interest at the end of each year. Make a table to show the year-end \$ amounts for years 1-10.

.015

x	$300(1.015)^x$	y
1	$300(1.015)^1$	304.5
2	$300(1.015)^2$	309.07
3	$300(1.015)^3$	313.70
4	$300(1.015)^4$	318.41
5		323.19
6		
7		
8		
9		
10		

X	Y1
0	300
1	304.5
2	309.07
3	313.7
4	318.41
5	323.19
6	328.03
7	332.95
8	337.95
9	343.02
10	348.16

X=10

2) Write the equation to model this growth:

$$y = 300(1.015)^x$$

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2) Exponential Decay (losing value) - \$10,000 is invested in the stock market and the account loses 3% of its value each year for 6 consecutive years. Make a table of values and write the equation that models this.

.3%

$$y = 10{,}000(0.97)^x$$

x		y
1	-300	9,700
2		9,409
3		9126.73
4		
5		
6		

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6.4 Exponential Growth & Decay DAY ONE with work

<u>What You Will Learn:</u>

- Use and identify exponential growth & decay functions
- Interpret & rewrite exponential growth & decay functions.
- Solve real-life problems involving exponential growth & decay.

<u>Core Vocabulary:</u>

exponential growth

exponential growth function

exponential decay

exponential decay function

compound interest

a. Write an exponential growth function that represents the attendance after t years.

b. How many people will attend the festival in the fifth year? Round your answer to the nearest thousand.

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Exponential Growth & Decay Functions

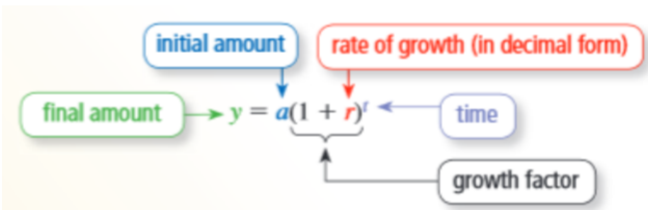
Exponential growth occurs when a quantity increases by the same factor over equal interval's of time.

Core Concept

A function of the form $y = a(1 + r)^t$, where $a > 0$ and $r > 0$, is an exponential growth function.

STUDY TIP

Notice that an exponential growth function is of the form $y = ab^x$, where b is replaced by $1 + r$ and x is replaced by t.



Example: Using an Exponential Growth Function

The inaugural attendance of an annual music festival is 150,000. The attendance y increases by 8% each year.

$y=a(1+r)^x$

$a=150{,}000$
$r=0.08$

$$\boxed{y=150{,}000(1+0.08)^x}$$

Practice:

1. A website has 500,000 members in 2010. The number y of members increases by 15% each year.

a) Write an exponential growth function that represents the website membership t years after 2010.

$y=a(1+r)^x$

$a=500{,}000$
$r=0.15$

$$\boxed{y=500{,}000(1+0.15)^x}$$

b) How many members will there be in 2016? Round your answer to the nearest ten thousand. $x=6$

$\boxed{y=500\,000(1.15)^6}$

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500000(1.15)^6
        1156530.383
```

$\boxed{\approx 1{,}160{,}000 \text{ members}}$

Exponential decay occurs when a quantity decreases by the same factor over equal intervals of time.

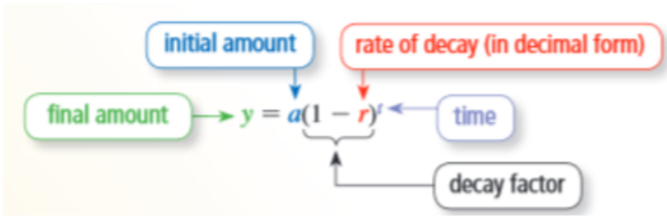
Core Concept

Exponential Decay Functions

A function of the form $y = a(1 - r)^t$, where $a > 0$ and $0 < r < 1$, is an exponential decay function.

STUDY TIP

Notice that an exponential decay function is of the form $y = ab^x$, where b is replaced by $1 - r$ and x is replaced by t.



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For exponential growth, the value inside the parentheses is greater than 1 because r is added to 1. For exponential decay, the value inside the parentheses is less than 1 because r is subtracted from 1.

EXAMPLE 2 Identifying Exponential Growth and Decay

Determine whether each table represents an *exponential growth function*, an *exponential decay function*, or *neither*.

a.

x	y
0	270
1	90
2	30
3	10

÷3 ÷3 ÷3

exponential decay

b.

x	0	1	2	3
y	5	10	20	40

·2 ·2 ·2

exponential growth

SOLUTION

a.

x	y
0	270
1	90
2	30
3	10

+1, +1, +1; $\times\frac{1}{3}$, $\times\frac{1}{3}$, $\times\frac{1}{3}$

As x increases by 1, y is multiplied by $\frac{1}{3}$. So, the table represents an exponential decay function.

b.

x	0	1	2	3
y	5	10	20	40

+1, +1, +1; ×2, ×2, ×2

As x increases by 1, y is multiplied by 2. So, the table represents an exponential growth function.

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Example:

"r" is the rate of change, make sure it is a percent in your final answer. $y = a(1 \pm r)^t$

Determine whether each function represents *exponential growth* or *exponential decay*. Identify the percent rate of change.

a. $y = 5(1.07)^t$ exponential growth

r = 0.07 so 7%

$a = 5$
$r = 0.07$

$\boxed{7\% \text{ Growth}}$

Solution

b. $f(t) = 0.2(0.98)^t$ exponential decay

r = 0.02 so 2%

$a = 0.2$
$r = 0.02$

$\boxed{2\% \text{ Decay}}$

Solution

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Example

$500 invested ... 12% interest rate ... 7 years

How much $$ after 7 years?

$a = 500$

$r = 0.12$

$x = 7$

$$y = 500(1 + 0.12)^7$$

$$\boxed{= \$1{,}105.34}$$

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500(1.12)^7
      1105.340704
```

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Example:

The table shows the balance of a money market account over time.

Write a function that represents the balance after t years.

Year, *t*	Balance
0	$100
1	$110
2	$121
3	$133.10
4	$146.41
5	$161.05

```
L1    L2       L3     2     EDIT CALC TESTS
0     100      ------       4↑LinReg(ax+b)
1     110                   5:QuadReg
2     121                   6:CubicReg
3     133.1                 7:QuartReg
4     146.41                8:LinReg(a+bx)
5     161.05                9:LnReg
                            0:ExpReg
L2(7) =
```

```
ExpReg
y=a*b^x
a=100.0001183
b=1.099999024
r²=.9999999999
r=.9999999999
```

$$\boxed{y = 100(1.1)^x}$$

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6.4 Exponential Growth & Decay DAY ONE with work

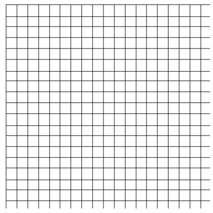
Practice:

The value of a car is $21,500. It loses 12% of its value every year.

a) Write a function that represents the value y (in dollars) of the car after t years.

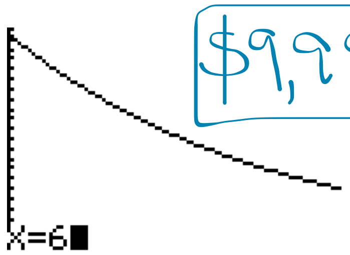
$y = a(1-r)^t$

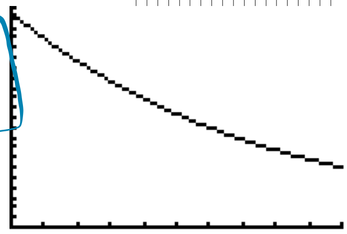
$\boxed{y = 21{,}500(1-0.12)^t}$

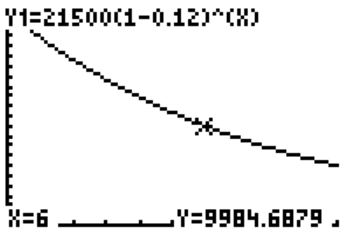


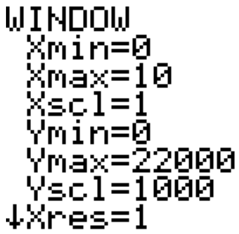
b) Graph the function from part (a). Use the graph to estimate the value of the car after 6 years.

$\boxed{\$9{,}984.69}$









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6.4 DAY ONE Assignment:

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