Warm Up

Use the simple interest formula, $I = Prt$, where I = interest, P = principle, r = interest rate, and t = time in years, to find the interest.

1. $P = \$3500$, $r = 5\%$, $t = 3$ years — $I = 3{,}500 \cdot .05 \cdot 3$, $I = 525$
2. $P = \$250{,}000$, $r = 7\%$, $t = 8$ years — $I = 250{,}000 \cdot .07 \cdot 8$, $I = 140000$
3. $P = \$6000$, $r = 9\%$, $t = 3$ years — $I = 6{,}000 \cdot .09 \cdot 3$, $I = 1620$
4. $P = \$15{,}000$, $r = 7\%$, $t = 7$ years — $I = 15{,}000 \cdot .07 \cdot 7$, $I = 7350$

Essential Question

What kinds of situations can be modeled with exponential growth or exponential decay functions?

Needed Vocab:

- **Compound Interest**
- **Decay Factor**
- **Exponential Decay**
- **Exponential Growth**
- **Growth Factor**

Goal: "I can. . .

Use exponential functions to model situations and make predictions."

The value of a car is shown in the diagram to the right depending on the years after the purchase. Find the function that models the value of the car.

$f(x) = 10{,}000 \cdot .8498^x$

+1 ↓ .8466 ↓ .8466 ↓ .8541 ↑ Avg. .8498

Example 1

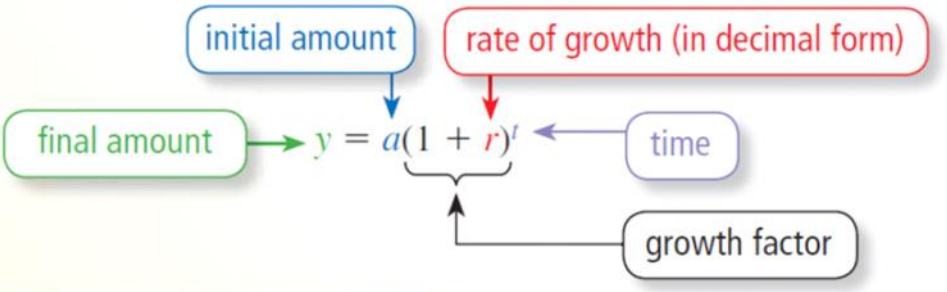
The population of Hillville grows at an annual rate of 15%. What will the estimated population of Hillville be in five years?

$f(x) = 5{,}000(1.15)^x$

initial Amount; 100% + growth%

Exponential Growth Functions

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



1. The population of Valleytown is also 5,000, with an annual increase of 1,000. Can the expected population for Valleytown be modeled with an exponential growth function? Explain.

No, it's linear since it's not increasing by a %

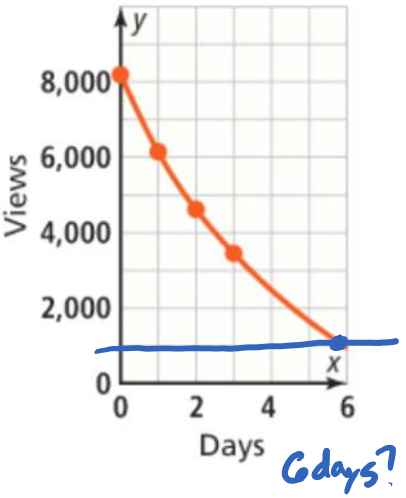
Example 2

A video is labeled a fan favorite if it receives at least 1,000 views per day. Amelia posts a video that gets 8,192 views on the first day. The number of views decreases by 25% each day after that. In how many days total will the video stop being a fan favorite?

Number of Days	Views
0	8,192
1	6,144
2	4,608
3	3,456

4 2592
5 1944
6 1458
7 1093.5
8 820.175
9

8 days



6 days?

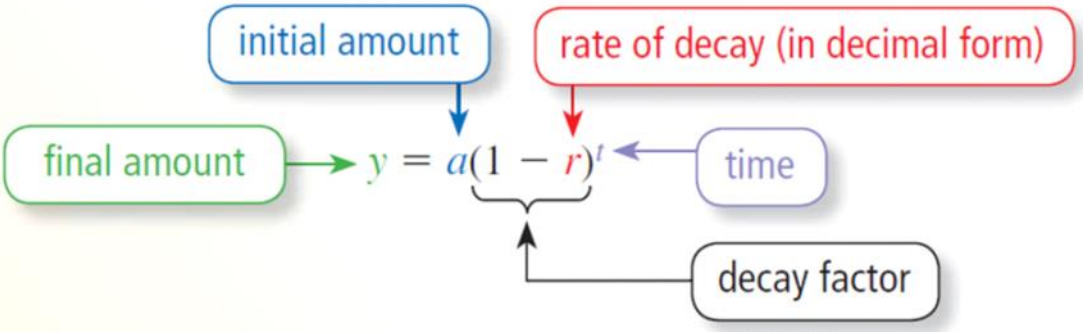
$h(x) = 8192(.75)^x$

$h(8) = 8192(.75)^8$

$h(8) = 820.175$

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**.



A video is labeled a fan favorite if it receives at least 1,000 views per day. Amelia posts a video that gets 8,192 views on the first day.

3. Suppose the number of views decreases by 20% per day. In how many days will the number of views per day be less than 1,000?

$h(x) = 8192(.80)^x$

$h(10) = 879.61$ ← 10 days

$h(9) = 1099.51$

Interest

Interest is calculated in two ways: simple interest and compound interest.

Simple interest is interest paid only on the principal.

Compound interest is interest that is paid both on the principal and on the interest that has already been paid. The compound interest formula is an exponential growth function.

Compound Interest Formula

Compound Interest Formula

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

A = amount paid
P = principal amount
r = rate of interest
n = number of times per year the interest is compounded
t = time in years

Example 3

Kimberly's family invested in a Certificate of Deposit (CD) for her when she was born. The interest is compounded quarterly.

A. What is the value of the CD at the end of five years?

B. Will the value of Kimberly's CD be greater after 15 years if it is compounded annually rather than quarterly?

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

$A = 3{,}000\ (1.02)^{4t}$

$t = 5$ $A = 3{,}000(1.02)^{20}$

$A = 4457.84$

$t = 15$

$A = 3{,}000\ (1.02)^{60}$

$A = 9843.09$

$A = 3{,}000(1.08)^{t}$

$t = 15$

$A = 3{,}000(1.08)^{15}$

$A = 9516.51$

Compounded quarterly yields more $

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2. Kimberly's family invested in a Certificate of Deposit (CD) for her when she was born. The interest is compounded quarterly.

a. What will be the difference after 15 years if the CD is compounded semiannually rather than quarterly?

$A = 9843.09$

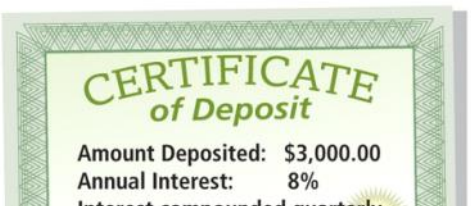
$A = 3{,}000\ (1.04)^{2t}$

$A = 9730.19$

$9843.09 - 9730.19$

$112.90 more quarterly

b. What will be the difference after 15 years if the CD is compounded monthly rather than quarterly?



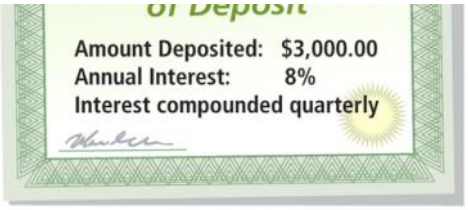
$A = 3{,}000\ (1 + \frac{.15}{150})^{12t}$

$A = 3{,}000\ (1.15/150)^{180}$

$A = 9920.76$

$- 9843.09$

from monthly



A = 9920.76
− 9843.09
77.67 more from monthly

Exponential Growth and Decay

	Exponential Growth	Exponential Decay	Compound Interest
ALGEBRA	$f(x) = a \cdot b^x$ $f(x) = a(1 + r)^x$	$f(x) = a \cdot b^x$ $f(x) = a(1 - r)^x$	$f(x) = a \cdot b^x$ $A = P\left(1 + \frac{r}{n}\right)^{nt}$
NUMBERS	$f(x) = 4(1 + 0.5)^x$	$f(x) = 4(1 - 0.5)^x$	$A = 5\left(1 + \frac{0.12}{2}\right)^{2t}$
WORDS	initial value: 4 growth rate: 50% growth factor: 1.5	initial value: 4 decay rate: 50% decay factor: 0.5	principal: 5 annual interest rate: 12% periods per year: 2

https://tinyurl.com/scgxh8d

Homework

Pg. 237
12, 15-23 odd, 30, 31