Algebra 1 7.6
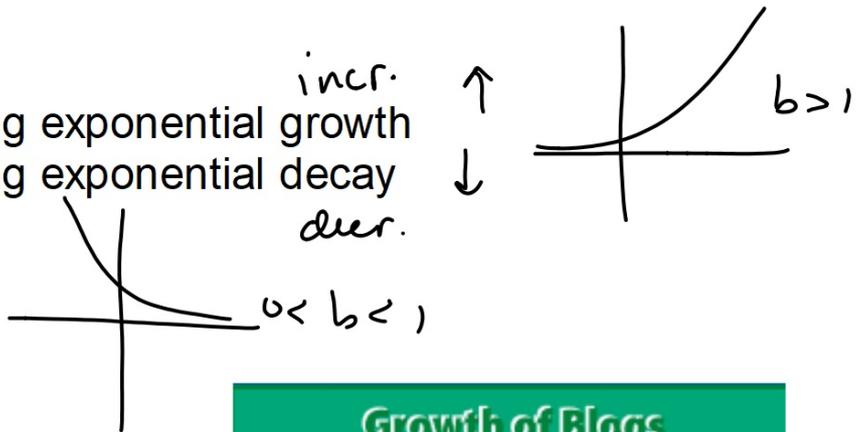Solve problems involving exponential growth
Solve problems involving exponential decay
exponent
base
whiteboards

incr. ↑

$b > 1$

der. ↓

$0 < b < 1$

Growth of Blogs

Number (millions)

Month

increases

1 Exponential Growth

Exponential Growth The equation for the number of blogs is in the form $y = a(1 + r)^t$. This is the general equation for exponential growth.

KeyConcept Equation for Exponential Growth

Start — **a** is the initial amount.

t is time.

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

end up / final — **y** is the final amount.

r is the rate of change expressed as a decimal, $r > 0$.

What is the unit for time? (Can vary...need to know what it is for each problem)

GuidedPractice

↑ 0.05

1. **TUITION** A college's tuition has risen 5% each year since 2000. If the tuition in 2000 was $10,850, write an equation for the amount of the tuition t years after 2000. Predict the cost of tuition for this college in 2015.

$2000, \ \$10,850$

1. Write equation (must have a variable)
2. Use the equation (answer the question)

GemA

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

a) $\quad y = 10,850(1.05)^t$

∧

b) $\quad y = 10,850(1.05)^{15}$

$\quad = 10,850(2.0789...)$

$\quad = 22556.37076$

$\quad = \$22,556.37$

Compound interest is interest earned or paid on both the initial investment and previously earned interest. It is an application of exponential growth.

$n = $ compounding periods

KeyConcept Equation for Compound Interest

A is the current amount.

n is the number of times the interest is compounded each year, and t is time in years.

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

P is the principal or initial amount.

r is the annual interest rate expressed as a decimal, $r > 0$.

Will give this formula on quiz/test if needed (but you have to know what to do with it). Time is always in YEARS for CI.

monthly $n = 12$
weekly $n = 52$
daily $n = 365$
biannual $n = 2$
quarterly $n = 4$

$t = $ years

If n = 12:
They get 1/12 of their interest 12 times per year.

If n = 4:
They get 1/4 of their interest 4 times per year.
etc.

monthly
annually
quarterly
etc.

Ge

P   0.06   n = 12

FINANCE Maria's parents invested $14,000 at 6% per year compounded monthly. How much money will there be in the account after 10 years?

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

$$= 14{,}000\left(1 + \frac{0.06}{12}\right)^{12t}$$

$$= 14{,}000\left(1.005\right)^{12 \cdot 10}$$

$$= 14{,}000\left(1.8194\ldots\right)$$

$$= \$25471.55$$

2. FINANCE Determine the amount of an investment if $300 is invested at an interest rate of 3.5% compounded monthly for 22 years.

$$0.035 \qquad\qquad n = 12$$

$$A = 300\left(1 + \frac{0.035}{12}\right)^{12 \cdot 22}$$

$$\$647.20$$

KeyConcept Equation for Exponential Decay (decrease)

a is the initial amount.   *t* is time.

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

y is the final amount.

r is the rate of decay expressed as a decimal, $0 < r < 1$.

How is this formula different from the exponential increase formula?
Time unit can vary...

Equation for Exponential Growth

a is the initial amount.   *t* is time.

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

y is the final amount.

r is the rate of change expressed as a decimal, $r > 0$.

t Equation for Exponential Decay

a is the initial amount.   *t* is time.

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

y is the final amount.

r is the rate of decay expressed as a decimal, $0 < r < 1$.

Is it getting more (growth) or less (decay)?

Real-World Example 3 Exponential Decay

0.066

SWIMMING A fully inflated child's raft for a pool is losing 6.6% of its air every day. The raft originally contained 4500 cubic inches of air.

a. Write an equation to represent the loss of air.

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

Must have a variable!

$$y = 4500(1 - 0.066)^t$$

b. Estimate the amount of air in the raft after 7 days.

$$y = 4500(0.934)^7$$

$$2790.23 \text{ in}^3$$

Is it increasing (+) or decreasing (-)?

3. **POPULATION** The population of Campbell County, Kentucky, has been decreasing at an average rate of about 0.3% per year. In 2000, its population was 88,647. Write an equation to represent the population since 2000. If the trend continues, predict the population in 2010.

Equations need a variable!

a)
$$y = 88647(1 - 0.003)^t$$

b)
$$= 88647(0.997)^{10}$$
$$86,023 \text{ people}$$

a

CONTEST The prize for a radio station contest begins with a $100 gift card. Once a day, a name is announced. The person has (15 minutes) to call or the prize increases by 2.5% for the next day.

0.025

a. Write an equation to represent the amount of the gift card in dollars after t days with no winners.

must have a variable

$$y = 100\left(1 + 0.025\right)^{t}$$

β^{434}

4 – 13 all