Applications of the Rules of Exponents with Word Problems

Applications of the Rules of Exponents with Word Problems Unit 9 Day 11

Percents and phenomena that grow at a constant percent rate can be challenging, to say the least. This is due to the fact that, unlike linear phenomena, the growth rate indicates a constant multiplier effect instead of a constant additive effect (linear). Because constant percent growth is so common in everyday life (not to mention in science, business, and other fields), it's good to be able to **mindfully manipulate percent**.

***Exercise* #1:** A population of kangaroos is growing at a constant percent rate. If the population on January 1st is 1027 and a year later is 1079, what is its yearly percent growth rate to the nearest *tenth* of a percent?

$A(t) = a(1 \pm r)^t$

$\frac{1079}{1027} = \frac{1027(1+r)^1}{1027}$

$1.0506 = 1+r$

$.0506 = r$

$\times 100$

$5.06 \sim 5.1\%$

Exercise #2: Now let's try to determine what the percent growth in the kangaroo population will be over a decade (10 yrs) of time. We will assume that the rounded percent increase found in *Exercise #1* continues for the next decade.

(a) After 10 years, what will we have multiplied the original population by, rounded to the nearest hundredth?

$(1+.051)^t$

$(1.051)^t$

$(1.051)^{10}$

1.64

(b) Using your answer from (a), what is the decade percent growth rate?

64%

Exercise #3: Let's stick with our kangaroos from Exercise #1. Assuming their growth rate is constant over time, what is their monthly growth rate to the nearest tenth of a percent? Assume a constant sized month.

$(1.051)^y$

$m = 12y$

$\frac{1}{12}m = y$

$\left((1.051)^{1/12}\right)^m$

1.004^m

$.4\%$

$(2^2)^3 = 2^{2\cdot 3}$

Exercise #4: If a population was growing at a constant rate of 22% every 5 years, then what is its percent growth rate over a 2-year time span? Round to the nearest tenth of a percent.

(a) First, give an expression that will calculate the single year (or yearly) percent growth rate based on the fact that the population grew 22% in 5

(b) Now use this expression to calculate the percent growth over 2 years.

***Exercise* #5**: Last year the total revenue for Wegmans increased by 6.25% over the previous year. If this trend were to continue, which expression could the company's chief financial officer use to approximate their monthly percent increase in revenue? (Let m represent months.)

$1.0625^{1/12}$

1. $(1.0625)^{m}$
2. $(1.0625)^{12/m}$
3. $(1.00506)^{m}$
4. $(1.00506)^{m/12}$

***Exercise* #6**: A study of the annual population of the red-winged blackbird in ~~Ft. Mill, South~~ Carolina, shows the population, B(t), can be represented by the function $B(t) = 750(1.16)^{t}$ y, where the t represents the number of years since the study began.

In terms of the monthly rate of growth, the population of red-winged blackbirds can be best approximated by the function

1. ~~$B(t) = 750(1.012)^{t}$~~ m y
2. $B(t) = 750(1.012)^{12t}$ m m
3. ~~$B(t) = 750(1.16)^{12t}$~~ y
4. ~~$B(t) = 750(1.16)^{t/12}$~~ y

$1.16^{1/12} = 1.012$

Exercise #7: Iridium-192 is an isotope of iridium and has a half-life of 73.83 days. If a laboratory experiment begins with 100 grams of Iridium-192, the number of grams, ***A***, of Iridium-192 present after ***t days*** would be $A = 100\left(\frac{1}{2}\right)^{\frac{t}{73.83}}$. Which equation approximates the amount of Iridium-192 present after *t* days?

1. $A = 100\left(\frac{73.83}{2}\right)^{t}$
2. $A = 100\left(\frac{1}{147.66}\right)^{t}$
3. $A = 100(0.990656)^{t}$
4. $A = 100(0.116381)^{t}$

$\left(\left(\frac{1}{2}\right)^{\frac{1}{73.83}}\right)^{t} = .990656$

or sub in

x= ____

Exercise #8: An equation to represent the value of a car after t months of ownership is $v = 32,000(0.81)^{\frac{t}{12}}$. Which statement is not correct?

1. The car lost approximately 19% of its value each ~~month~~. year
2. The car maintained approximately 98% of its value each month.
3. The value of the car when it was purchased was $32,000.
4. The value of the car 1 year after it was purchased was $25,920.

$32000(.81)^{12/12}$

$\left(.81^{1/12}\right)^m$

$(.98)^m$

HW 9-10

1. (2) $192
2. Setauket Equation $S(t) = 6200(1.08)^t$
   Stony Brook Equation $B(t) = 8750(1.06)^t$
   See windows, graph, and tables on the next slides

   During the 18th year or by the 19th year.
3. $247
4. Option A $A(n) = 10000(1.035)^n$
   Option B $B(n) = 10000(1 + .0325/4)^{4n}$
   Option A by $932.22
5. 4%

Name________________________ Alg 2 HW 9-10

1. If $130 is invested in a savings account that earns 4% interest per year, which of the following is closest to the amount in the account at the end of 10 years?

(1) $218 (3) $168

(2) $192 (4) $324

$A(t) = 130(1.04)^t$

$A(10) = 130(1.04)^{10}$

$= \$192.43$

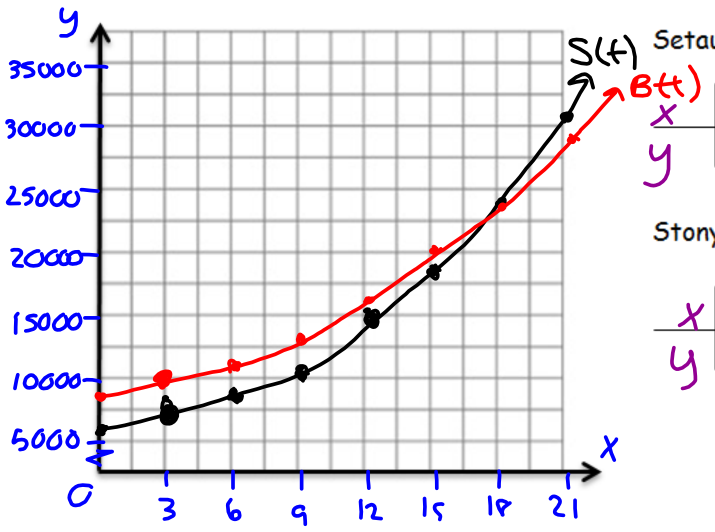
2. Setauket has a population of 6,200 people and is growing at a rate of 8% per year. Stony Brook has a population of 8,750 and is growing at a rate of 6% per year. In how many years, to the nearest year, will Setauket have a greater population than Stony Brook? Show the equation or inequality you are solving and solve it graphically.

Setauket Equation $S(t)=6200(1.08)^t$

Stony Brook Equation $B(t)=8750(1.06)^t$

Values may vary

Setauket Window		Stony Brook Window	
x-min	0	x-min	0
x-max	30	x-max	30
y-min	0	y-min	0
y-max	40000	y-max	40000



Setauket

x	0	3	6	9	12	15	18	21
y	6200	7810	9839	12394	15613	19667	24775	31210

Stony Brook

x	0	3	6	9	12	15	18	21
y	8750	10421	12412	14783	17607	20970	24975	29746

3. \$200 is deposited in a bank account. The interest is compounded monthly at a rate of 4.25%. How much money is in the account after 5 years, to the nearest dollar?

$a = \$200$

$r = .0425$

$t = 5$

$A(5) = 200\left(1 + \frac{.0425}{12}\right)^{12(5)}$

$= \$247$

4. Ben's parents gave him \$10,000 for his 18th birthday. He is considering two investment options. Option A will pay him 3.50% interest compounded annually. Option B will pay him 3.25% interest compounded quarterly. Write a function of Option A and Option B that calculates the value after n years.

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Option A $A(n) = 10000(1.035)^n$

Option B $B(n) = 10000\left(1 + \frac{.0325}{4}\right)^{4n}$

Ben wants to use the money in 22 years to buy a sports car. Determine which plan would yield the greatest return and by how much.

$A(22) = 10000(1.035)^{22}$

$= \$21315.11$

$B(22) = 10000\left(1 + \frac{.0325}{4}\right)^{4(22)} = \$20382.89$

Option A by \$932.22

5. A house purchased 10 years ago for $80,000 was just sold for $120,000. Assuming exponential growth, approximate the annual growth rate, to the *nearest percent*.

$$\frac{120{,}000}{80000} = \frac{80{,}000(1+r)^{10}}{80000}$$

$$\sqrt[10]{1.5} = \sqrt[10]{(1+r)^{10}}$$

$$1.04 = 1+r$$

$$-1 \qquad -1$$

$r = .04$

4%