Inspiring Greatness

ISD

INDEPENDENCE SCHOOL DISTRICT

Math Virtual Learning

Algebra IIB

Exponential Growth or Decay

April 22, 2020

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Lesson: April 22, 2020

Objective/Learning Target: Students will solve real-world exponential growth or decay problems

Let's Get Started:

Compound Interest is a specific example of exponential **GROWTH.** Solve the following problem (review of April 20th lesson):

1. Sarah invested $2000 in a mutual fund that earned 8% quarterly. How much money did she have after 5 years?

Half-life is a specific example of exponential **DECAY**. Solve the following problem (review of April 21st lesson):

2. Actinium-226 has a half-life of 29 hours. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

Answers to “Let’s Get Started”

Problem 1:

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

$$A = 2000\left(1 + \frac{.08}{4}\right)^{4 \cdot 5}$$

$$A = 2971.89$$

Sarah would have $2971.89

Problem 2

$$A = A_0\left(\frac{1}{2}\right)^{\frac{t}{h}}$$

$$A = 100\left(\frac{1}{2}\right)^{\frac{58}{29}}$$

$$A = 25$$

There would be 25 g of Actinium-226 remaining

General Formula for Growth and Decay

$$A = A_o(r)^t$$

A_o: the original amount of what is being measured

If $r>1$ is growth, If $0<r<1$ is decay

If r is expressed as a percent, turn it to a decimal. **ADD** to 1 for growth and **SUBTRACT** from 1 for decay

t is time in whatever units are given in the problem

Example 1: Growth

The population of a small town was 3600 in 2005. The population increases by 4% annually. Approximately how many people lived in this this town in 2010?

Step 1: Define the variables:

$A_0=3600$

$t=5$ (2010-2005)

$r = 1 + .04 = 1.04$

Step 2: Fill in the formula:

$A=A_0(r)^t$

$A=3600(1.04)^5$

Step 3: Simplify

$A=4379.95$

The population is approximately 4380.

Example 2: Decay

Your car cost $42,500 when you purchased it in 2015. The value of the car depreciates by 15% annually. How much is it worth in 2020?

Step 1: Define the variables:

A_0=42500
R = 1 - .15 = 0.85
t=5 (2020-2015)

Step 2: Fill in the formula:

$A=A_0(r)^t$

$A=42500(0.85)^5$

Step 3: Simplify:

A=$18857.48

Your Turn!

Example 1: You bought $2000 worth of stock.

a. The value of the stocks decreases by 10% each year. What will the stock be worth in 10 years?
b. The value of the stock increases by 10% each year. What will the stock be worth in 10 years?
c. At 10%, will your stock lose or gain more?

Answer to Example 1:

Part A:

$A_0=2000$

$t=10$

$r = 1 - .1 = 0.9$

$A=2000(0.9)^{10}$

$A=\$697.36$

Part B:

$A_0=2000$

$t=10$

$r = 1 + .1 = 1.1$

$A=2000(1.1)^{10}$

$A=\$5187.48$

Part C:

It grows more

Solving for Time

Because time is in the exponent, you need to turn the equation into a logarithm.

$$A = A_0(r)^t \rightarrow \frac{A}{A_0} = r^t \rightarrow \ln\left(\frac{A}{A_0}\right) = \ln r^t \rightarrow \ln\left(\frac{A}{A_0}\right) = t \cdot \ln r$$

$$\rightarrow t = \frac{\ln\left(\frac{A}{A_0}\right)}{\ln(r)}$$

Your Turn!

Example 2: A piece of land was purchased for $65,000. The value of the land has slowly been decreasing by 1% annually. How long until it is only worth $10,000?

Answer to Example 2:

Variables:

$A_0=65000$

$A=10000$

$r = 1 - .01 = 0.99$

Formula:

$A=a_0(r)^t$

$10000=65000(0.99)^t$

$\ln(10000/65000)=t\cdot\ln(.99)$

$t=\ln(10000/65000)/\ln(0.99)$

$t=186.24$

Part C:

It will be worth $10000 in about 186 years.

Independent Practice

Do the attached worksheet.
The answers are on the next slide.

Exponential Growth and Decay Worksheet

Answers to Exponential Growth and Decay