Lesson 2.09 Exponential Functions with Time Adjustments

Students will be able to:

- <u>Content Objective:</u> Express exponential functions using different growth rates (monthly, weekly, daily) in terms different measures of time.
- <u>Language Objective:</u> Explain how laws of exponents aids in manipulating exponential equations and expressions.

Warm Up

A student studying political science created a model for the population of Denver, where the population decreased 22% over a year. She used the model $P = 815(0.78)^t$, where P is the population, in thousands, t years after the year 2000. Another student, Lisa, wants to use a model that would predict the population after m months. Lisa's model is best represented by what equation. Write it below.

Skill 1: Rates Over One Hour vs. Multiple Hours

I. Scientist are studying new bacterium. They create a culture with 200 of the bacteria and anticipate that the number of bacteria will double every hour.

II. Scientist are studying new bacterium. They create a culture with 200 of the bacteria and anticipate that the number of bacteria will double every 20 hours.

a. What is different between the descriptions in part I. and part II. above?

b. Write an equation for the number of bacteria, B, in terms of the number of hours, t since the experiment began for part I.

c. Write an equation for the number of bacteria, B, in terms of the number of hours, t since the experiment began for part II. Explain why this equation makes sense.

Exercise 1: Rates over One Minute vs. Multiple Minutes

When observed by researchers under a microscope, an ipad screen contained approximately 50,000 bacteria per square inch. Bacteria, under normal conditions, double in population every 20 minutes. Assuming an initial value of 50,000, write a function $B(t)$, that can be used to model the population of bacteria, B, on an iPad screen, where t represents the time in minutes after it is first observed under a microscope.

Skill 2: Half-Life

The half-life of a radioactive substance is 20 years.

a. Write an equation that can be used to determine the amount, $r(t)$, of 400 grams of this substance that remains after t years.

b. Determine, to the *nearest year*, how long it will take for half of this substance to remain. Use a calculator.

Exercise 2: Half-Life

Titrum, a radioactive isotope of hydrogen, has a half-life of 144 months.

a. If a laboratory experiment begins with 100 grams of Titrum, write an equation that represents the number of grams A, of Titrum present after t months.

b. Which equation below approximates the amount of Titrum present after t months?

(1) $A = 100\left(\frac{144}{2}\right)^t$

(2) $A = 100\left(\frac{1}{0.995}\right)^t$

(3) $A = 100(4.4842)^t$

(4) $A = 100(0.995198)^t$

Consider the same word problem from the warmup. Let's see how we can compare what we learned in the last lesson with what we learned in today's lesson.

Check Point

A student studying political science created a model for the population of Denver, where the population decreased 22% over a decade. She used the model $P = 815(0.78)^d$, where P is the population, in thousands, d decades after the year 2000. Another student, Lisa, wants to use a model that would predict the population after y years. Lisa's model is best represented by

(1) $P = 815(0.6800)^y$

(2) $P = 815(0.8800)^y$

(3) $P = 815(0.9755)^y$

(4) $P = 815(0.9700)^y$

2.09- Problem Set

Name: ____

1. A student for their statistics project created a model for the population of Albuquerque, where the population decreased 25% over a decade. She used the model $P = 720(0.75)^d$, where P is the population, in thousands, d decades after the year 2010. Another student, Lisa, wants to use a model that would predict the population after y years. Lisa's model is best represented by

   (1) $P = 720(0.971642)^y$

   (2) $P = 720(0.75)^y$

   (3) $P = 720(0.0563135)^y$

   (4) $P = 720(0.65)^y$

2. A house purchased 6 years ago for $200,000 was just sold for $245,000. Assuming exponential growth, approximate the annual growth rate, to the nearest percent.

3. Researchers are studying a new bacterium and create a culture of 500 of the bacteria. They anticipate that the number of bacteria will double every 35 hours.

   a. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

   b. How many hours will it take for the number of bacteria to triple? Use a calculator and round to the *nearest year*.