Lesson 3.07 Systems of Exponential and Logarithmic Equations

Students will be able to:

- Content Objective: Solve a system containing logarithms.
- Language Objective: Read a word problem describing a system of exponential functions and graph the system.

Warm Up

The value of a new car depreciates over time. Danny purchased a new car in June 2014. The value, V, of his car after t years can be modeled by the equation $\log_{0.7}\left(\frac{V}{19{,}000}\right) = t$. What is the average decreasing rate of change per year of the value of the car from June 2015 to June 2017, to the *nearest ten dollars per year?*

Vocabulary Review

Fill in the blanks below with the word that best fits the description.

- A system of equations is __________ or more equations.
- The graphical solution to a system of equations is the _______________ point.

Skill 1: Determining the Number of Solutions to a System

After examining the function $h(x) = \ln(x+3)$ and $k(x) = e^{x-2}$ over the interval $(-3,4]$, James determined that the correct number of solutions to the equation $h(x) = k(x)$ is

(1) 0 (3) 3

(2) 2 (4) 1

Exercise 1: Determining the Number of Solutions to a System

How many solutions are there to the equation $f(x) = g(x)$, where $f(x) = \ln(x)$ and $g(x) = \ln(x) - 2$?

(1) 0 (3) 3

(2) 2 (4) 1

Skill 2: Solving Systems Algebraically

Statisticians are studying the population of bats in a specific area and found that the initial population of 30 grew continuously at the rate of 6% per month. They also study the population of mice and found that the initial population of 50 grew continuously at the rate of 3% per month.

Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

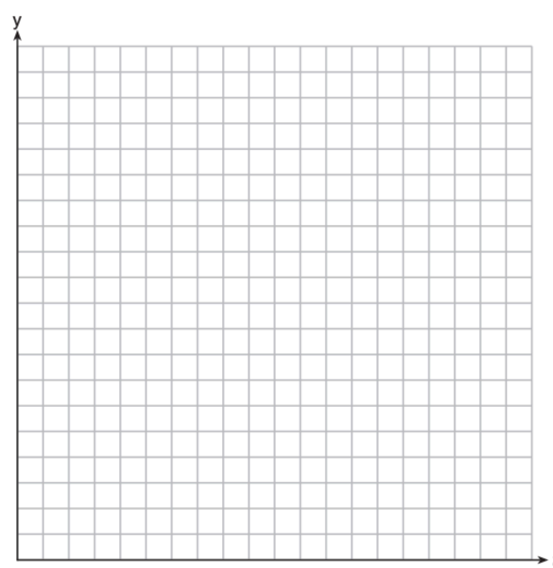
Read it Out

Drugs break down in the human body at different rates causing doctors to be extra cautious to prevent complications such as overdosing. The breakdown of a drug in the human body can be represented by the function $D(t) = D_0(e)^{-rt}$, where $D(t)$ is the amount of the drug left in the body, D_0 is the initial dosage, r is the decay rate, and t is time in hours since the drug was taken. Bethany, $B(t)$, is given 700 milligrams of a drug with a decay rate of 27.4%. Justin, $J(t)$, is given 300 milligrams of a drug with a decay rate of 17.3%.

a. Write two functions $B(t)$ and $J(t)$, to represent the breakdown of the respective drug given to each patient.

b. Graph each function on the set of axes below.

c. To the *nearest hour*, t, when does the amount of the given drug remaining in Justin the same as the amount of the drug remaining in Bethany?



d. The doctor will allow Bethany to take another 700 milligram dose of the drug once 20% of the original dose is left in the body. Determine, to the *nearest tenth of an hour*, how long Bethany will have to wait to take another 700 milligram dose of the drug.

3.07- Problem Set

Name: ____

1. To the nearest tenth, find the value of x that satisfies the equation $3^x = -2x + 9$.

2. Bailey's parents gave him \$2000 to invest for his 18th birthday. He is considering two investment options. Option A will pay him 4.6% interest compounded annually. Option B will pay him 4.7% compounded quarterly.

   Write two functions, one for option A and one for option B, that calculates the value of each account after n years.

3. When $g(x) = \frac{3}{x+1}$ and $h(x) = \log(x+2) + 3$ are graphed on the same set of axes, what would be their intersection point? Round both values to the nearest hundredth.