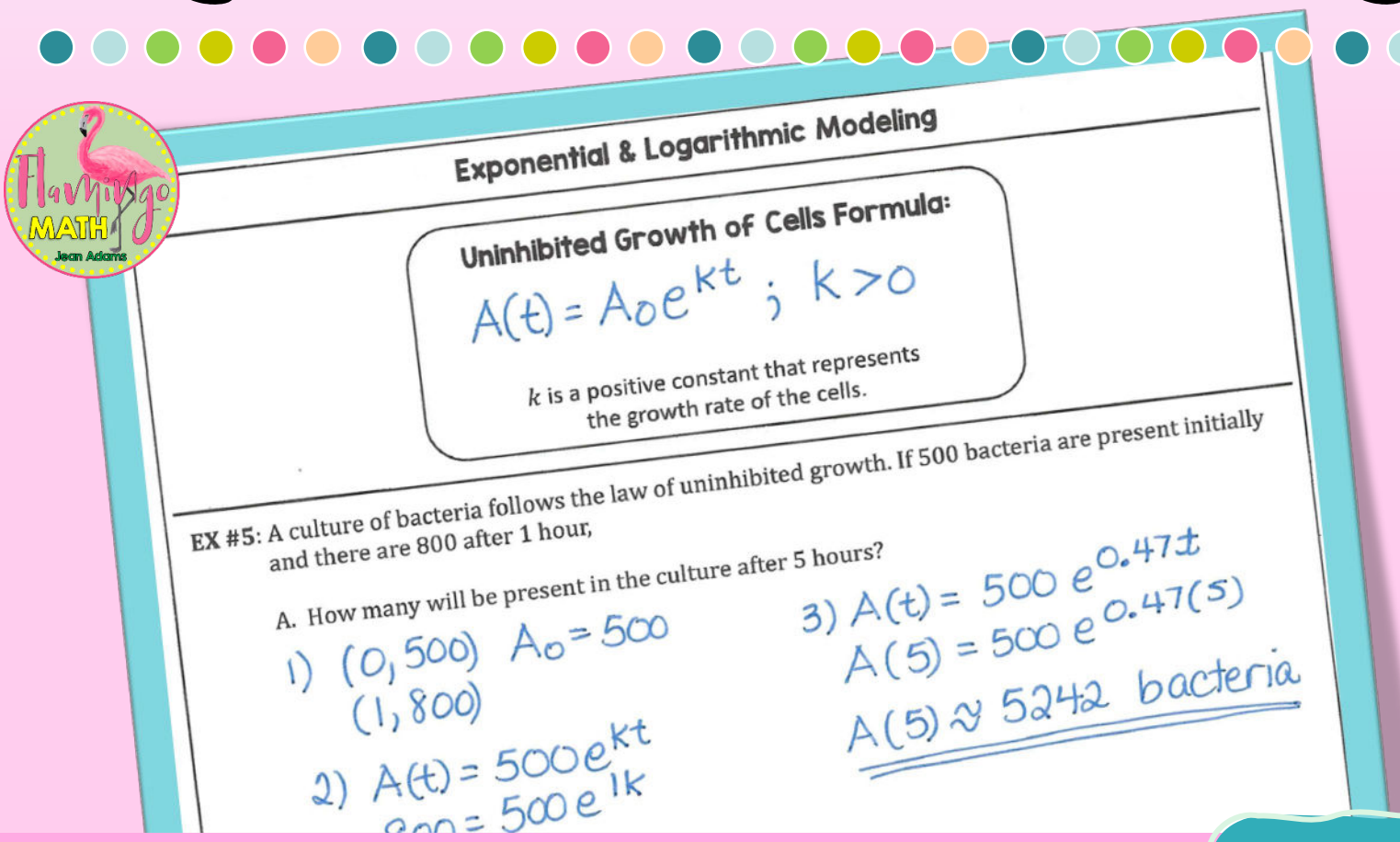
Precalculus Honors

Exponential, Logistic & Logarithmic Modeling



Completely Editable

3.5

Lesson 5: Exponential, Logistic and Logarithmic Modeling

Logistic Modeling

EX #1: The function $f(t) = \frac{64{,}000}{1+4500e^{-1.2t}}$ describes the number of people, $f(t)$, who have become ill with a flu outbreak t weeks after its initial discovery within a town of 64,000 people.

A. How many people were ill at the beginning of the epidemic?

B. How many people were ill at the end of the 4th week?

C. What is the limiting size of $f(t)$, the populati

Exponential Growth & Decay Modeling

For Examples #2 - 4, use $P(t) = P_0(1+r)^t$

EX #2: Determine the exponential function that is increasing at a rate of 6% per year and has an initial value $P_0 = 12$.

EX #3: Suppose a culture of 100 bacteria is put into a petri dish and the culture doubles every hour. Predict when the number of bacteria will be 250,000?

Solve Algebraically

Solve Graphically

Exponential & Logarithmic Modeling

Uninhibited Growth of Cells Formula:

k is a positive constant that represents the growth rate of the cells.

EX #5: A culture of bacteria follows the law of uninhibited growth. If 500 bacteria are present initially and there are 800 after 1 hour,

A. How many will be present in the culture after 5 hours?

B. How long before the culture contains 20,000 ba

Radioactive Decay

active substance is 40 days and there are 8 grams here will be 1 g (gram) of the substance remaining.

Using Regression

EX #6: A chemist has a 100-gram sample of a radioac amount of radioactive material at the end of t

Radioactive Substance	
Week	**Weight (in grams)**
0	100.0
1	90.4
2	76.8
3	69.7
4	58.2
5	49.7
6	44.2

A. Use a grap data. Writ

B. What is th

C. When will there be 10-grams of material left?

D. How much radioactive material will be left after 52 weeks?

Logistics Modeling

EX #7: Surfside High School has 1500 students. Max, Patti, Juan and Andrea start a rumor, which spreads logistically so that $S(t) = \frac{1500}{1+38e^{-0.9t}}$ models the number of students who has heard the rumor by the end of t days, where $t = 0$ is the day the rumor begins.

A. How many students have heard the rumor by the end of day 0?

B. How long does it take for 1000 students to hear the rumor?

NOTES

3.5 **Exponential, Logistic & Logarithmic Homework**

Name _____

Date _____ Period _____

Problems 1 – 10, Solve each scenario.

1. Fruit flies are laying eggs on a rotten grapefruit. Suppose that the population $P(t)$ after t days is modeled by $P(t) = \frac{240}{1+18.6e^{-0.38t}}$.

   A. What is the carrying capacity of the grapefruit?

   B. How many fruit flies were initially on the grapefruit?

   C. When will the population of fruit flies be 150?

2. The number N of bacteria in a culture is modeled by $N(t) = 250e^{kt}$, where t is the time in hours. If $N = 340$ when $t = 4$, find the time required for the population to double in size.

3. When construction on an Interstate highway began, it was necessary to move a population of elk to a protected area. The logistic growth function models the population t years after they were introduced into the new habitat is: $P(t) = \frac{650}{1+40e^{-0.16t}}$.

   A. How many elk were initially moved to the new habitat?

   B. How many elk will be expected in the new habitat after 10 years?

   C. What is the limiting size of the elk herd that the habitat can sustain?

4. The half-life of a certain radioactive substance is 24 years. A sample has 5.8 grams present initially.

   A. Write a model to express the amount of the substance remaining as a function of time t.

   B. When will there be less than 1 gram remaining?

5. In 1989, a San Francisco construction crew unearthed skeletal remains. It was shown that the skeletons had 88% of the expected amount of carbon-14 that is found in a living person. By using the exponential decay model for carbon-14, predict how old the skeletons were in 1989.
   Exponential decay model: $A(t) = A_0e^{-0.000121t}$

6. The wind speed s (in miles per hour) near the center of a tornado is related to the distance d (in miles) that the tornado travels by the equation $s(d) = 93\log d + 65$.
   A tornado whose wind speed was 270 miles per hour struck a town in Oklahoma.
   How far did the tornado travel?

7. Mr. Craig's students took a PreCalculus test and then tested every month with a similar exam. The average scores for class can be modeled by $f(t) = 80 - 17\log(t+1)$ for $0 \le t \le 12$, where t is the time in months.

   A. Find the average score of students on the original test.

   B. Find the average score after 6 months.

8. The Richter scale is used to measure earthquakes. The magnitude of an earthquake is modeled by the equation $R = 0.67\log(0.37E) + 1.46$, where E is the energy in kilowatt-hours, released by the earthquake.

   A. How many kilowatt-hours of energy is released in an earthquake that measures 8.5 on the Richter scale?

   B. Find the magnitude of an earthquake that releases 15,000,000,000 kilowatt-hours of energy.

9. A pizza baked in an over at 475°F is removed from the oven into a room that is a constant 75°F. After 10 minutes the pizza temperature is at 350°F.

   A. Find the time it takes for the pizza to reach 175°F.

   B. If you want to eat the pizza when the temperature is 145°F, how long will you wait?

10. You have taken a filet mignon out of the freezer to thaw. The steak is 28°F and is placed on the counter in a room with the constant temperature of 73°F. After 10 minutes, the temperature of the steak has risen to 34°F.

    A. What is the temperature of the steak after 30 minutes?

    B. How long will it take before the steak thaws to a temperature of 60°F?

11. Find the time, in years, it takes to double an investment of $5,000.00 at 9% when the interest is compounded continuously, using $A = Pe^{rt}$

Practice Sets

Lesson Warm-Ups

Name _____ Date _____ Period _____

Lesson 3.5: Exponential, Logistic, and Logarithmic Modeling: Warm-Up # 1

1. Identify the function as growth or decay, find the constant percentage rate of the growth or decay.

$P(t) = 3.5(1.0324)^t$

2. The population of an endangered lizard after t years is modeled by the function: (Use for problems 2 – 4)

$$P(t) = \frac{1015}{1 + 24e^{-0.4t}}$$

What is the initial population?

3. What is the population in 10 years?

4. When will the population reach 1000?

Name _____ Date _____ Period _____

Lesson 3.5: Exponential, Logistic, and Logarithmic Modeling: Warm-Up # 2

1. Identify the function as growth or decay, find the constant percentage rate of the growth or decay.

$P(t) = 3.5(1.0324)^t$

2. The population of an endangered lizard after t years is modeled by the function: (Use for problems 2 – 4)

$$P(t) = \frac{1230}{1 + 45e^{-0.4t}}$$

What is the initial population?

3. What is the population in 10 years?

4. When will the population reach 1000?

Daily Lesson Quiz

3.5 Exponential, Logistic & Logarithmic Modeling **Form A**

Name _____

Date _____ Period _____

1. Identify the function as either growth or decay, find the constant percentage rate of growth or decay. $P(t) = 2.9\ (1.0125)^t$

Problems 2-4,
The population of an endangered rabbit after t years in a protected park is modeled by the function:

$$P(t) = \frac{1025}{1 + 85e^{-0.3t}}$$

2. What is the initial population of rabbits?

3. What is the population of the rabbits in 10 years?

4. When will the number of rabbits reach 800?

Grade:

3.5 Exponential, Logistic & Logarithmic Modeling **Form B**

Name _____

Date _____ Period _____

1. Identify the function as either growth or decay, find the constant percentage rate of growth or decay. $P(t) = 3.4\ (0.9215)^t$

Problems 2-4,
The population of an endangered rabbit after t years in a protected park is modeled by the function:

$$P(t) = \frac{1042}{1 + 64e^{-0.2t}}$$

2. What is the initial population of rabbits?

3. What is the population of the rabbits in 10 years?

4. When will the number of rabbits reach 600?

Grade: