GUIDED NOTES – 6.7 EXPONENTIAL AND LOGARITHMIC MODELS

LEARNING OBJECTIVES

In this section, you will:

- Model exponential growth and decay.
- Use Newton's Law of Cooling.
- Use logistic-growth models.
- Choose an appropriate model for data.
- Express an exponential model in base e.

MODELING EXPONENTIAL GROWTH AND DECAY

Study the box in your textbook section titled "characteristics of the exponential function, $y = A_o e^{kt}$".

- An exponential function with the form $y = A_o e^{kt}$ has the following characteristics:

  - ________________ function
  - Horizontal asymptote: ___________
  - Domain: ___________
  - Range: ___________
  - x-intercept: ___________
  - y-intercept" ___________
  - Increasing if ___________ and decreasing if ___________

- Write the half-life formula below.

- Write out the 3 step process for finding the decay rate, given the half-life.

   1.

   2.

   3.

Try It: Read Example 2 in the text, then answer the following.

The half-life of plutonium-244 is 80,000,000 years. Find the function that gives the amount of plutonium-244 remaining as a function of time, measured in years.

- Write out the 2 step process for determining the age, given the percentage of carbon-14 in an object.

   1.

   2.

Try It: Read Example 3 in the text, then answer the following.

Cesium-137 has a half-life of about 30 years. If we begin with 200 mg of cesium-137, will it take more or less than 230 years until only 1 milligram remains?

Try It: Read Example 4 in the text, then answer the following.

Recent data suggests that, as of 2013, the rate of growth predicted by Moore's Law no longer holds. Growth has slowed to a doubling time of approximately three years. Find the new function that takes that longer doubling time into account.

<u>USING NEWTON'S LAW OF COOLING</u>

Study the box in your textbook section titled "Newton's Law of Cooling".

- The temperature of an object, T, in surrounding air with temperature T, will behave according to the formula

$$T(t) = \underline{\qquad\qquad\qquad}, \text{ where}$$

t is _____________

The difference between the initial temperature of the object and the surroundings is _______

k is a ________________, the continuous rate of cooling of the object.

- Write out the 3 step process for applying Newton's Law of Cooling, given a set of conditions.

1.

2.

3.

Try It: Read Example 5 in the text, then answer the following.

A pitcher of water at 40 degrees Fahrenheit is placed into a 70 degree room. One hour later, the temperature has risen to 45 degrees. How long will it take for the temperature to rise to 60 degrees?

USING LOGISTIC GROWTH MODELS

- The logistic growth model is approximately ________________ at first, but it has a reduced rate of growth as the output approaches the model's upper bound, called the ________________________.

Study the box in your textbook section titled "logistic growth".

- The logistic growth model is

$f(x) =$ ______________, where

the initial value is ________________

c is the ________________________ or the ________________________

the constant determined by the rate of growth is _______

Try It: Read Example 6 in the text, then answer the following.

Using the model in **Example 6**, estimate the number of cases of flu on day 15.

CHOOSING AN APPROPRIATE MODEL FOR DATA

- What are the three kinds of functions that are often useful in mathematical models?

- When choosing between an exponential model or a logarithmic model we often look at the way the data curves, also called the _______________.

    1. An exponential curve is always concave _______ away from its horizontal asymptote
    2. A logistic curve changes _________________. It starts concave _______ then changes to concave _______ beyond a certain point called the point of _______________

Try It: Read Example 7 in the text, then answer the following.

Does a linear, exponential, or logarithmic model best fit the data in **Table 2**? Find the model.

x	1	2	3	4	5	6	7	8	9
y	3.297	5.437	8.963	14.778	24.365	40.172	66.231	109.196	180.034

Table 2

EXPRESSING AN EXPONENTIAL MODEL IN BASE e

- Write out the 3 step process for changing a model to the form $y = A_o e^{kx}$, given a model with the form $y = ab^x$.

    1.

    2.

    3.

Try It: Read Example 8 in the text, then answer the following.

Change the function $y = 3(0.5)^x$ to one having e as the base.