WS #4-8

Exponential Growth and Decay, Newton's Law; Logistic Growth and Decay

1. You will be responsible to read the section completely and review the definitions and applications.
   - A. Exponential Law
   - B. Law of Uninhibited Growth and Decay
   - C. Half-Life
   - D. Newton's Law of Cooling
   - E. Logistic model
   - F. Carrying capacity

2. A colony of bacteria grows according to the law of uninhibited growth according to the function $N(t) = 100e^{0.045t}$, where N is measured in grams and t is in days:
   - A. Determine the initial amount of bacteria
   - B. What is the growth rate of the bacteria?
   - C. Graph the function on your calculator
   - D. What is the population after 5 days?
   - E. How long will it take for the population to reach 140 grams?
   - F. What is the doubling time for the population?

3. A colony of bacteria grows according to the law of uninhibited growth.
   - A. If the number of bacteria doubles in 3 hours, find the function that gives the number of cells in the culture.
   - B. How long will it take the size of the colony to triple?
   - C. How long will it take for the population to double a second time (that is, increase four times)?

4. Traces of burned wood along with ancient stone tools in an archeological dig in Chile were found to contain approximately 1.67% of the original amount of carbon 14. If the half-life of carbon 14 is 5600 years, approximately when was the tree cut and burned?

5. An object is heated to 100° C and is then allowed to cool in a room whose air temperature is 30° C.
   - A. If the temperature of the object is 80° after 5 minutes, when will the temperature be 50°C?
   - B. What is the temperature at 18.6 minutes? (use graphing calc)
   - C. Determine the elapse time before the object is 35°. (use graphing calc)
   - D. What do you notice about the temperature as time passes?

6. Fruit flies are placed in a half-pint milk bottle with a banana (for food) and yeast plants (for food and to provide a stimulus to lay eggs). Suppose that the fruit fly population after t days is given by

$$P(t) = \frac{230}{1 + 56.5e^{-0.37t}}$$

   - A. State the carrying capacity and growth rate.
   - B. Determine the initial population.
   - C. What is the population after 5 days
   - D. How long does it take for the population to reach 180?
   - E. How long does it take for the population to reach one-half of the carrying capacity?

7. Wood products can be classified by their life span. The percentage of remaining wood products with long life spans after t years is given by

$$P(t) = \frac{100.3952}{1 + 0.0316e^{0.0581t}}$$

   - A. What is the decay rate?
   - B. What is the percentage of remaining wood products after 10 years?
   - C. How long does it take for the percentage of remaining wood products to reach 50 %?