PC – Trig Name _____

Solving Logarithmic & Exponential situations

Newton's Law of Cooling: $T(t) = T_a + (T_0 - T_a)e^{-kt}$

$Where\ T_a\ is\ the\ surrounding\ air\ temperature\ and\ T_0\ is\ the\ initial\ temperature.$

Here k is a constant that depends on the liquid and the environment. We solve for the temperature T at time t.

In most applications of this law, we need to solve for k and/or t. Since both k and t are exponents, we must use logarithms.

1. Suppose the water in a hot tub is heated to $150°$. After the heater is turned off, the hot tub takes an hour to cool to $120°$. The temperature of the surrounding air is $80°$.

   a. Use Newton's Law of Cooling to find the temperature of the hot tub after 3 hours.

   b. Now let us suppose that we want to know the time t this hot tub will cool down to $85°$.

2. The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude is given by $R = 0.67\log(0.37E) + 1.46$ where E is the energy (in kilowatt-hours) released by the earthquake.

   a. An earthquake releases 15,500,000,000 kilowatt-hours of energy. What is the earthquake's magnitude?

   b. How many kilowatt-hours of energy would an earthquake have to release in order to be a 8.5 on the Richter scale.

3. The wind speed s (in miles per hour) near the center of a tornado is related to the distance d (in miles) the tornado travels by the equation $s = 93\log d + 65$.

   a. On March 18, 1925, a tornado whose wind speed was about 280 miles per hour struck the Midwest. How far did the tornado travel?

4. Jonas purchased a new car for $15,000. Each year the value of the car depreciates by 30% of its value the previous year. In how many years will the car be worth $500 (use the simple interest rate formula of $y = ab^t$?

5. Brad created a chart that shows the population of a town will increase to 96,627 people from a current population of 11,211 people. The rate of increase is an annual increase of 4.18%. Brad forgot to include the number of years this increase will take. How many years was it? (Solve algebraically using $A = Pe^{rt}$ for population growth.)