PRECALCULUS GT/HONORS
Worksheet 1 on Logistical Growth

A population that experiences **exponential growth** increases according to the model

$$n = n_0 e^{rt}$$

where $n =$ population at time t
$n_0 =$ initial size of the population
r = relative rate of growth (expressed as a proportion of the population)
t = time

Radioactive Decay Model

If m_0 is the initial mass of a radioactive substance with half-life h, then the mass remaining at time t is modeled by the function

$$m = m_0 e^{-rt},$$

where $r = \dfrac{\ln 2}{h}$.

Newton's Law of Cooling: If D_0 is the initial temperature difference between an object and its surroundings, and if its surroundings have temperature T_S. then the temperature of the object at time t is modeled by the function

$$T = T_S + D_0 e^{-kt},$$

where k is a positive constant that depends on the type of object.

Work the following on **notebook paper**. Give decimal answers correct to **three** decimal places.

1. The population of a certain city was 112,000 in 1998 and 117,000 in 2000.
(a) Find a function that models the population after t years.
(b) Find the projected population in the year 2004.
(c) In what year will the population reach 200,000?

2. The frog population in a small pond grows exponentially. The current population was 85 frogs in 1999 and 102 frogs in 2001.
(a) Find a function that models the population after t years.
(b) Find the number of frogs in 2005.
(c) Find the number of years required for the frog population to reach 600.

3. A culture contains 1500 bacteria initially and doubles every 30 minutes.
(a) Find a function that models the number of bacteria after t minutes.
(b) Find the number of bacteria after 2 hours.
(c) After how many minutes will the culture contain 4000 bacteria?

4. The population of the world was 5.7 billion in 1995 and 5.93 billion in 1997. Assume that the population grows exponentially.
(a) What will the population be in 2008?
(b) By what year will the population have doubled?

5. The half-life of radium-226 is 1600 years. Suppose we have a 22-mg sample.
(a) Find a function that models the mass remaining after t years.
(b) How much of the sample will remain after 4000 years?
(c) After how long will only 18 mg of the sample remain?

6. A wooden artifact from an ancient tomb contains 65% of the carbon-14 that is present in living trees. How long ago was the artifact made? (The half-life of carbon-14 is 5730 years.)

7. A hot bowl of soup is served at a dinner party. It starts to cool according to Newton's Law of Cooling so that its temperature at time t is given by $T = 65 + 145e^{-0.05t}$, where t is measured in minutes and T is measured in °F.
(a) What is the initial temperature of the soup?
(b) What is the temperature after 10 minutes?
(c) After how long will the temperature be 100°F?

8. A roasted turkey is taken from an oven when its temperature has reached 185°F and is placed on a table in a room where the temperature is 75°F.
(a) If the temperature of the turkey is 150°F after half an hour, what is its temperature after 45 minutes?
(b) When will the turkey cool to 100°F?