Advanced PreCalculus
Chapter 3 Application Examples

Section 3.1

1. A total of $4000 is invested at an annual rate of 5.25%, compounded monthly. Find the balance in the account after 6 years.

2. Determine the amount of money that should be invested at 9% interest, compounded monthly, to produce a final balance of $30,000 in 15 years.

3. Let *Q* represent the mass, in grams, of radium (^{226}Ra), whose half-life is 1620 years. The mass of radium present after t years is given by $Q = 16\left(\frac{1}{2}\right)^{t/1620}$.

a) What is the initial mass?
b) What is the mass after 1000 years?

4. A city's population is growing at a rate of 8%. After *t* years, the population is given by $P(t) = 450{,}000e^{0.08t}$.

a) Find the initial population.
b) Find the population after 20 years.
c) Graph *P(t).*

5. Let Q represent the mass, in grams, of radium (^{226}Ra), whose half-life is 1599 years. The mass of radium present after *t* years is given by $Q = 25\left(\frac{1}{2}\right)^{t/1599}$.

a) What is the initial mass?
b) What is the mass after 1000 years?
c) When will the quantity of radium be 0 grams? Explain.

6. In early 2010, a new sedan had a manufacturer's suggested retail price (MSRP) of $31,915. After *t* years, the sedan's value is given by $V(t) = 31915\left(\frac{4}{5}\right)^{t}$.

a) What does 4/5 mean in this example?
b) Find the value of the sedan after 1 year? 5 years? 10 years?
c) How many years will it take for the sedan to have a value of $5000?

Section 3.2

1. Students in a math class were give an exam and then retested monthly with an equivalent exam. The average scores for the class are given by the human memory model $f(t) = 78 - 17\log(t + 1)$, $0 \le t \le 12$, where *t* is the time in months.

a) What was the average score on the original exam ($t = 0$)?
b) What was the average score after 3 months? after 11 months?

Section 3.3

1. The relationship between the number of decibels β and the intensity of a sound I in watts per square meter is given by $\beta = 10 \log_{10} \left(\frac{I}{10^{-12}}\right)$.

a) Use properties of logarithms to write the formula in a simpler form.

b) Complete the table:

I	10^{-4}	10^{-6}	10^{-8}	10^{-10}	10^{-12}	10^{-14}
β						

2. Students participating in a psychology experiment attended several lectures and were given an exam. Every month for the next year, the students were retested to see how much of the material they remembered. The average score for the group are given by the human memory model $f(t) = 90 - 15\log(t + 1)$, $0 \leq t \leq 12$, where t is the time in months.

a) What is the average score on the original test?

b) What was the average in 6 months? in 12 months?

c) When did the average score decrease to 75?

Section 3.4

1. You have deposited $1000 in an account that pays 6.25% interest, compounded continuously. How long will it take your money to double?

2. The numbers y of endangered animal species in the world from 1996 through 2009 can be modeled by $y = 702 + 79 \ln t$, $6 < t < 19$, where t represents the year. During which year did the number of endangered animal species reach 923?

3. The population P (in thousands) of Pittsburgh, Pennsylvania from 2000 through 2008 can be modeled by $P = 333.68e^{-0.0099t}$, where t is the year, with $t = 0$ corresponding to 2000.

a) According to the model, was the population of Pittsburgh increasing or decreasing from 2000 through 2008? Explain.

b) What were the populations of Pittsburgh in 2000, 2005, and 2008?

c) According to the model, when will the population of Pittsburgh be approximately 290,000?

4. Carbon 14 (^{14}C) dating assumes that the carbon dioxide on Earth today has the same radioactive content as it did centuries ago. If this is true, then the amount of ^{14}C absorbed by a tree that grew several centuries ago should be the same as the amount of ^{14}C absorbed by a tree growing today. A piece of ancient charcoal contains only 15% as much radioactive carbon as a piece of modern charcoal. How long ago was the tree burned to make the ancient charcoal given that the half-life of ^{14}C is 5700 years?

5. A bottle of spring water with an initial temperature of 72°F is placed in a freezer with a temperature of 29°F. After 15 minutes, the temperature of the water drops to 55°F. The equation for the drop in temperature is $T_f = T_r + (T_o - T_r)e^{-rt}$, where T_f is the final temperature of the object after t minutes, T_r is the temperature of the surrounding air, T_o is the original temperature of the object and r is the rate at which the object is cooling. Find the rate of cooling, r, and then determine how long it will take the water to reach 32°F.