## 9.1 Exponential Functions #25, 26
For Exercises 25 and 26, use the following information.

**25.** Write an exponential function to model the population $y$ of bacteria after $x$ days.
**26.** How many bacteria are there after 6 days?

## 9.2 Logarithms & Logarithmic Functions #2, 4-6

**2. POWERS** Haley tries to solve the equation $\log_4 2x = 32$. She got the wrong answer. What was her mistake? What should the correct answer be?

| 1. | $\log_4 2x = 5$ |
|----|------------------|
| 2. | $2x = 4^5$ |
| 3. | $x = 2^5$ |
| 4. | $x = 32$ |

**4. LOGARITHMS** Pauline knows that $\log_b x = 3$ and $\log_b y = 5$. She knows that this is the same as knowing that $b^3 = x$ and $b^5 = y$. Multiply these two equations together and rewrite it as an equation involving logarithms. What is $\log_b xy$?

**MUSIC For Exercises 5 and 6, use the following information.**

The first note on a piano keyboard corresponds to a pitch with a frequency of 27.5 cycles per second. With every successive note you go up the white and black keys of a piano, the pitch multiplies by a factor of $\sqrt[12]{2}$. The formula for the frequency of the pitch sounded when the $n$th note up the keyboard is played is given by

$$n = 1 + 12 \log_2 \frac{f}{27.5}.$$

**5.** The pitch that orchestras tune to is the A above middle C. It has a frequency of 440 cycles per second. How many notes up the piano keyboard is this A?

**6.** Another pitch on the keyboard has a frequency of 1760 cycles per second. How many notes up the keyboard will this be found?

## 9.3 Properties of Logarithms #2-4, 32

**2. POWERS** A chemist is formulating an acid. The pH of a solution is given by

$$-\log_{10} C,$$

where C is the concentration of hydrogen ions. If the concentration of hydrogen ions is increased by a factor of 100, what happens to the pH of the solution?

**3. LUCKY MATH** Frank is solving a problem involving logarithms. He does everything correctly except for one thing. He mistakenly writes

$$\log_2 a + \log_2 b = \log_2 (a + b).$$

However, after substituting the values for $a$ and $b$ in his problem, he amazingly still gets the right answer! The value of $a$ was 11. What must the value of $b$ have been?

**4. LENGTHS** Charles has two poles. One pole has length equal to $\log_7 21$ and the other has length equal to $\log_7 25$. Express the length of both poles joined end to end as the logarithm of a single number.

**32.** An earthquake rated at 3.5 on the Richter scale is felt by many people, and an earthquake rated at 4.5 may cause local damage. The Richter scale magnitude reading $m$ is given by $m = \log_{10} x$, where $x$ represents the amplitude of the seismic wave causing ground motion. How many times greater is the amplitude of an earthquake that measures 4.5 on the Richter scale than one that measures 3.5?

## 9.4 Common Logarithms #29-31
**29.** Siberian irises flourish when the concentration of hydrogen ions $[H+]$ in the soil is not less than $1.58 \times 10^{-8}$ mole per liter. What is the pH of the soil in which these irises will flourish?

**30.** The pH of vinegar is 2.9 and the pH of milk is 6.6. How many times greater is the hydrogen ion concentration of vinegar than of milk?

**31.** There are initially 1000 bacteria in a culture. The number of bacteria doubles each hour. The number of bacteria $N$ present after $t$ hours is $N = 1000(2)^t$. How long will it take the culture to increase to 50,000 bacteria?

## 9.5 Base e & Natural Logarithms #4-7
**4. POPULATION** The equation $A = A_0 e^{rt}$ describes the growth of the world's population where $A$ is the population at time $t$, $A_0$ is the population at $t = 0$, and $r$ is the annual growth rate. How long will take a population of 6.5 billion to increase to 9 billion if the annual growth rate is 2%?

**MONEY MANAGEMENT For Exercises 5–7, use the following information.**

Linda wants to invest $20,000. She is looking at two possible accounts. Account A is a standard savings account that pays 3.4% annual interest compounded continuously. Account B would pay her a fixed amount of $200 every quarter.

**5.** If Linda can invest the money for 5 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?

**6.** If Linda can invest the money for 10 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?

**7.** If Linda can invest the money for 20 years only, which account would give her the higher return on her investment? How much more money would she make by choosing the higher paying account?

## 9.6 Exponential Growth and Decay #2, 4-7
**2. CARBON DATING** Archeologists uncover an ancient wooden tool. They analyze the tool and find that it has 22% as much carbon–14 compared to the likely amount that it contained when it was made. Given that the half-life of carbon–14 is about 5730 years, about how old is the artifact? Round your answer to the nearest 100 years.

**4. POPULATION** Louisa read that the
population of her town has increased
steadily at a rate of 2% each year. Today,
the population of her town has grown
to 68,735. Based on this information,
what was the population of her town
100 years ago?

**CONSUMER AWARENESS** **For Exercises**
**5–7, use the following information.**

Jason wants to buy a brand new high-
definition (HD) television. He could buy
one now because he has $7000 to spend,
but he thinks that if he waits, the quality
of HD televisions will improve. His $7000
earns 2.5% interest annually compounded
continuously. The television he wants to buy
costs $5000 now, but the cost increases each
year by 7%.

**5.** Write a natural base exponential
function that gives the value of Jason's
account as a function of time $t$.

**6.** Write a natural base exponential
function that gives the cost of the
television Jason wants as a function
of time $t$.

**7.** In how many years will the cost of the
television exceed the value of the money
in Jason's account? In other words, how
much time does Jason have to decide
whether he wants to buy the television?
Round your answer to the nearest tenth
of a year.