1. **PROGRAMMING** For reasons having to do with speed, a computer programmer wishes to model population size using a natural base exponential function. However, the programmer is told that the users of the program will be thinking in terms of the annual percentage increase. Let \( r \) be the percentage that the population increases each year. Find the value for \( k \) in terms of \( r \) so that 

\[
e^k = 1 + r.
\]

\[ k = \ln (1 + r) \]

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.

\[ 12,500 \text{ yr} \]

3. **POPULATION** The doubling time of a population is \( d \) years. The population size \( y \) can be modeled by an exponential equation of the form \( y = ae^{kt} \), where \( a \) is the initial population size and \( t \) is time. What is \( k \) in terms of \( d \)?

\[ k = \frac{1}{d} \ln 2 \]

4. **POPULATION** Louisa read that the population of her town has increased steadily each year. Today, the population of her town has grown to 68,735. One year ago, the population was 67,387. Based on this information, what was the population of her town 100 years ago?

about 9484

5. **CONSUMER AWARENESS** 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%.

a. Write a natural base exponential function that gives the value of Jason’s account as a function of time \( t \).

\[ 7000e^{0.025t} \]

b. Write a natural base exponential function that gives the cost of the television Jason wants as a function of time \( t \).

\[ 5000e^{(\ln 1.07)t} \]

c. 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.

7.9 yr

6. **LOGISTIC GROWTH** The population of a bacteria can be modeled by

\[ P(t) = \frac{22,000}{1 + 1.2e^{-kt}} \]

where \( t \) is time in hours and \( k \) is a constant.

a. After 1 hour the bacteria population is 10,532, what is the value of \( k \)?

0.0971

b. When does the population reach 21,900?

\[ t = 57.4 \text{ h} \]