Lesson 13 Practice Problems

1. The population of a town is growing exponentially and can be modeled by the equation $f(t) = 42 \cdot e^{(0.015t)}$. The population is measured in thousands, and time is measured in years since 1950.

   a. What was the population of the town in 1950?

   b. What is the approximate percent increase in the population each year?

   c. According to this model, approximately what was the population in 1960?

2. The revenue of a technology company, in thousands of dollars, can be modeled with an exponential function whose starting value is $395,000 where time t is measured in years after 2010.

   Which function predicts exactly 1.2% of annual growth: $R(t) = 395 \cdot e^{(0.012t)}$ or $S(t) = 395 \cdot (1.012)^t$? Explain your reasoning.

3. How are the functions f and g given by $f(x) = (1.05)^x$ and $g(x) = e^{0.05x}$ similar? How are they different?

4. a. A bond is worth \$100 and grows in value by 4 percent each year. Explain why the value of the bond after t years is given by $100 \cdot 1.04^t$.

   b. A second bond is worth \$100 and grows in value by 2 percent each half year. Explain why the value of the bond after t years is given by $100 \cdot (1.02)^{2t}$.

   c. A third bond is worth \$100 and grows in value by 4 percent each year, but the interest is applied continuously, at every moment. The value of this bond after t years is given by $100 \cdot e^{(0.04t)}$. Order the bonds from slowest growing to fastest growing. Explain how you know.

5. The population of a country is growing exponentially, doubling every 50 years. What is the annual growth rate? Explain or show your reasoning.

(From Unit 4, Lesson 6.)

6. Which expression has a greater value: $\log_3 \frac{1}{3}$ or $\log_b \frac{1}{b}$? Explain how you know.

(From Unit 4, Lesson 11.)

7. The expression $5 \cdot \left(\frac{1}{2}\right)^d$ models the amount of a radioactive substance, in nanograms, in a sample over time in decades, d. (1 nanogram is a billionth or 1×10^{-9} gram.)

   a. What do the 5 and the $\frac{1}{2}$ tell us in this situation?

   b. When will the sample have less than 0.5 nanogram of the radioactive substance? Express your answer to the nearest half decade. Show your reasoning.

   c. Show that only about 5 picograms of the substance will remain one century after the sample is measured. (A picogram is a trillionth or 1×10^{-12} gram.)

(From Unit 4, Lesson 7.)

8. Select **all** true statements about the number e.

A. e is a rational number.

B. e is approximately 2.718.

C. e is an irrational number.

D. e is between π and $\sqrt{2}$ on the number line.

E. e is exactly 2.718.

(From Unit 4, Lesson 12.)