1. Determine the behavior of the following exponential functions as $x \to \infty$ and as $x \to -\infty$.

(a) $y = 2^x$
   - As $x \to \infty$, $y \to ____$.
   - As $x \to -\infty$, $y \to ____$.

(b) $y = \left(\frac{1}{3}\right)^x$
   - As $x \to \infty$, $y \to ____$.
   - As $x \to -\infty$, $y \to ____$.

(c) $y = 1.01^x$
   - As $x \to \infty$, $y \to ____$.
   - As $x \to -\infty$, $y \to ____$.

(d) $y = 0.99^x$
   - As $x \to \infty$, $y \to ____$.
   - As $x \to -\infty$, $y \to ____$.

(e) $y = e^{-x}$
   - As $x \to \infty$, $y \to ____$.
   - As $x \to -\infty$, $y \to ____$. 
2. You deposit $1000 in a bank account with a nominal interest rate of 6%/year.

(a) Suppose that the interest compounds once per quarter. How much money will be in the account after 10 years?

(b) Suppose instead that the interest compounds monthly. How much money will be in the account after 10 years?

(c) Finally, suppose that the interest compounds continuously. How much money will be in the account after 10 years?

3. Samantha is deciding which of three banks to invest her money in. Bank A offers an annual interest rate of 7.5% compounded continuously; Bank B offers an annual interest rate of 7.6%, compounded weekly, and Bank C offers an annual interest rate of 7.7%, compounded twice a year. Which account will earn more interest in a year?
4. A 12-oz can of soda is put into a refrigerator to cool. Its temperature in Fahrenheit after $t$ minutes is given by the following formula:

$$T = 38 + 36e^{-0.02t}$$

(a) What is the initial temperature of the soda?

(b) What is the temperature of the soda after 30 minutes?

(c) What is the temperature inside the refrigerator?
5. In 1920, Pearl and Reed proposed a model for the population of the United States based on the years 1790, 1850, and 1910. The function they proposed was
\[ P(t) = \frac{2930}{0.0149 + e^{-0.0313t}} \]
where \( P \) is measured in thousands and \( t \) represents the number of years past 1790.
(a) Based on the model, determine the population of the US in 1790, 1850, and 1910.

(b) According to the model, what is the eventual population of the US?

6. At the beginning of a biology experiment, a bacteria culture contains 400 bacteria. An hour later, the number of bacteria has doubled. Assuming exponential growth, find a formula for the population of bacteria after \( t \) hours.
7. At noon, a bacteria culture contains 5000 bacteria. After two hours the population has increased to 9890.

(a) Assuming exponential growth, find a formula for the population of bacteria after $t$ hours?

(b) How many bacteria are in the culture at 7:30pm?

8. Suppose that $P(t) = 32(1.047)^t$ gives the population of a town in thousands after $t$ years. By what percent does the town grow every year?
9. In December 2005, Facebook had approximately 5.5 million active users worldwide. By December 2006, Facebook had approximately 11 million active users. If the number of Facebook users continues to double every year, how many users are there in year \( x \)?

10. Xanax is a tranquilizer used in the short-term relief of symptoms of anxiety. Its half-life in the bloodstream is 36 hours (meaning that after 36 hours, there is half as much in the bloodstream). Suppose that John initially has 1 mg of Xanax in his bloodstream.

   (a) Find a formula for the amount of Xanax in John’s bloodstream after \( t \) hours.

   (b) How much Xanax is in John’s bloodstream after 10 hours?