(15 points)

1. The graph of $f(t)$ below represents the depth in meters below the Atlantic Ocean floor where $t$ million-year-old rock can be found. *

   ![Graph of depth vs. time]

   *Data of Dr. Murlene Clark based on core samples drilled by the research ship *Glomar Challenger*, taken from *Initial Reports of the Deep Sea Drilling Project*.

   a. Evaluate $f(15)$ and say what it means in terms of the rock under the ocean floor.

   b. Evaluate $f^{-1}(120)$ and say what it means in terms of the rock under the ocean floor.

   c. Find the average rate of change of the function with respect to time from $t = 20$ to $t = 30$ and explain the meaning of this rate in the context of the rock under the ocean floor.
2. Find the equation of a line through the point \((\sqrt{2}, \pi)\) with slope \(7/3\).

(30 points)

3. The population of the United States is currently 314 million people\(^*\) and growing by 1.1% annually. Assume this trend continues.
   a. Write the estimated future U.S. population, \(P\) in millions of people, as a function of time, \(t\) years past 2012.
   b. How long will it take for the U.S. population to double?
   c. What is the continuous growth rate of the U.S. population? Write your answer in decimal form with at least 4 decimal places.

\(^*\)Fun Fact: On August 14, 2012, the Census Bureau estimated the U.S. population to be 314,159,265 (\(\pi\) hundred million people)!
4. What are the ranges of the sine and cosine functions if we restrict their domain to the interval [α, β] where α and β are the angle measures indicated in the diagram below? In other words, what values can \( \sin \theta \) and \( \cos \theta \) produce if \( \alpha \leq \theta \leq \beta \)?

\[
\begin{align*}
\quad \leq \sin \theta \leq \quad \\
\quad \leq \cos \theta \leq 
\end{align*}
\]

(15 points)

5. A cubic polynomial with negative leading coefficient is shown for \(-10 \leq x \leq 10\) and \(-10 \leq y \leq 10\) in the graph below.

Indicate the number of zeros the polynomial has in each of the following intervals:

\[
\begin{align*}
\infty < x < \infty : \\
\infty < x < -10 : \\
-10 < x < -5 : \\
-5 < x < 0 : \\
0 < x < 5 : \\
5 < x < 10 : \\
10 < x < \infty :
\end{align*}
\]
6. Let \( f(x) = \frac{4^x - 1}{x} \), which has a removable discontinuity (a hole) when \( x = 0 \). Let \( h = \lim_{x \to 0} f(x) \).

Without any fancy limit calculations, we can only approximate the value of \( h \). Give an interval of \( x \)-values where you can be sure that \( f(x) \) will approximate \( h \) to within an accuracy of 0.1? Explain your reasoning.