1.) Evaluate the following limits.

a.) \( \lim_{x \to 4} \frac{\sqrt{5 + x} - 3}{\sqrt{x} - 2} \)  

b.) \( \lim_{x \to \infty} (x - x \cos(4/x)) \)

c.) \( \lim_{x \to 0} \frac{2x}{\sin x} \)  

(HINT: \( \frac{\sin x}{x} \leq 1 \).)

2.) Use one-sided limits and limits to infinity to find all vertical and horizontal asymptotes for the following functions. Use the asymptotes together with x- and y-intercepts to sketch graphs of each function.

a.) \( y = \frac{x - 2}{x^2 - 9} \)  

b.) \( y = \frac{x + 2}{x^2(x + 1)} \)

3.) Give an \( \varepsilon, \delta \) -proof for \( \lim_{x \to 1} \frac{x + 3}{1 + \sqrt{x}} = 2 \).

4.) Use the IMVT to determine if the following equation is solvable. This is a writing exercise: \( x^3 + x - \sqrt{x + 4} = 0 \).

5.) In the given diagram the smaller circle is the largest one that can be inscribed in the given semi-circle. If the larger circle has circumference \( 4\pi \) in., what is the area of the inscribed shaded square?

6.) Determine the x-values for which the following function is continuous. It is not necessary to graph the function:

\[
  f(x) = \begin{cases} 
    \frac{\sin 3x}{x}, & \text{if } x < 0 \\
    3.01, & \text{if } x = 0 \\
    \frac{x - 1}{\sqrt{x} - 1}, & \text{if } 0 < x < 1 \\
    2, & \text{if } x \geq 1.
  \end{cases}
\]

7.) Use the limit definition of derivative, \( f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} \), to differentiate each of the following functions.

a.) \( f(x) = \cos x \)

b.) \( f(x) = \frac{7 + x}{3x - 5} \)

c.) \( f(x) = \sqrt{x^2 + x} \)
8.) Let $f(x) = \begin{cases} \sin 2x, & \text{if } x \geq 0 \\ 2x, & \text{if } x < 0 \end{cases}$. Use the limit definition of derivative to determine $f'(0)$.

The following problem is for recreational purposes only.

9.) Without lifting your pencil, join all sixteen dots with six straight lines.