(1) (20 pts.) Do the following for the function \( f(x) = \frac{x + 1}{x - 1} \).

(a) State the domain of \( f \).
(b) State the set of \( x \) values where \( f \) is continuous.
(c) Find the average rate of change for \( f(x) \) on the interval \([2, 3]\).
(d) Find the instantaneous rate of change of \( f \) at the point \( a = 2 \) using

\[
  f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}.
\]
(e) Find the equation of the tangent line to the curve \( y = f(x) \) at the point where \( x = 2 \).
(2) (10 pts.) For the function \( f(x) = 2x - x^2 \), find \( f'(x) \) using

\[
f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}
\]

(3) (10 pts.) Find the limit, if it exists, otherwise say why it does not exist.

(a) \( \lim_{x \to \infty} \frac{\sin 2x}{x} = \)

(b) \( \lim_{x \to \infty} 2x \cos x = \)

(4) (10 pts.) Find the limit, if it exists, otherwise say why it does not exist.

\[
\lim_{x \to 2} \frac{\sqrt{1 + 2x - \sqrt{5}}}{x - 2} =
\]
(5) (15 pts.) Answer the following for the function $f(x) = \frac{x^3}{1-x}$.

(a) State the set of $x$ values where $f$ is continuous:

(b) State the $x$-intercepts:

(c) Find the following limits, or say why the limit does not exist.

(i) $\lim_{x \to 0^-} f(x) =$

(ii) $\lim_{x \to 0^+} f(x) =$

(iii) $\lim_{x \to 1^-} f(x) =$

(iv) $\lim_{x \to 1^+} f(x) =$

(6) (20 pts.) Answer the following for the function $f(x) = \frac{x^2 - 4}{1-x^2}$

(a) Describe the domain. (b) Find the asymptotes. (c) Find the $x$-intercepts.

(d) Sketch the graph of $y = f(x)$. 
(7) (5 pts.) Use the given graph of \( f(x) = \sqrt{x} \) to find a number \( \delta \) such that 
\[
|\sqrt{x} - 1| < 0.1 \text{ whenever } 0 < |x - 1| < \delta
\]

(8) (5 pts.) The graph of \( y = f(x) \) is given. Sketch the graph of the derivative \( y = f'(x) \).

(9) (5 pts.) Find the limit, if it exists, otherwise say why it does not exist
\[
\lim_{x \to \infty} \frac{x^{1/2} - x^2}{x + 3} =
\]