(1) (25 pts.) Do the following for the function $f(x) = x(x + 2)$.

(a) Find the average rate of change for $f(x)$ on these intervals
   (i) $[-0.1, 0]$
   (ii) $[0, 0.1]$

(b) Find the instantaneous rate of change of $f$ at the point $a = 0$ using
   $$f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}.$$ 

(c) Find the equation of the tangent line to the curve at the point where $x = 0$.

(d) Sketch the graph of $y = f(x)$, including the graph of the tangent line at $x = 0$. 
(2) (10 pts.) Find the limit.
(a) \( \lim_{x \to 0} \frac{x}{(x-7)^2} \)  
(b) \( \lim_{x \to 7} \frac{x}{(x-7)^2} \)

(3) (15 pts.) Do the following for the function \( f(x) = \frac{1}{\sqrt{x}} \).
(a) State the domain of \( f(x) \).
(b) State the set of numbers on which \( f(x) \) is continuous.
(c) Use \( \lim_{x \to a} \frac{f(x) - f(a)}{x - a} \) to find \( f'(a) \).
(d) State the domain of \( f'(x) \).
(4) (10 pts.) Find the limit.

(a) \( \lim_{x \to \infty} \frac{2-x}{\sqrt{x^2 + 1}} \)

(b) \( \lim_{x \to \infty} \left( 9 - \frac{2}{x} + \frac{4}{x^3} \right) \)

(5) (20 pts.) Do the following for the function

\[ f(x) = \frac{1}{(x-1)(x-3)^2} \]

(a) State the domain of \( f(x) \).
(b) Describe the set of \( x \) values where \( f \) is discontinuous.
(c) Find the \( x \) and \( y \)-intercepts.
(d) Find the horizontal asymptotes.
(e) Find the vertical asymptotes.
(f) Sketch the graph of \( y = f(x) \).
(6) (10 pts.) Do the following for the function

\[ f(x) = \begin{cases} 
  x - 1 & \text{if } x < 0 \\
  (x - 1)^2 & \text{if } x \geq 0 
\end{cases} \]

(a) \( f(0) = \)
(b) \( \lim_{x \to 0} f(x) = \)
(c) State the set of \( x \) values on which \( f \) is continuous.

(7) (5 pts.) Use the given graph of \( f(x) \) to find a number \( \delta \) such that

\[ |f(x) - 1| < 0.1 \text{ whenever } 0 < |x - 1.5| < \delta \]

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