Problem 1 (25 Points):

A. If the limit exists find it. If the limit does not exist, say so; use \( \infty \) and \( -\infty \) when appropriate.

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

(b) \( \lim_{x \to 0} \frac{x^2}{\sqrt{x^2 + 4} - 2} \)

(c) \( \lim_{x \to -\infty} \frac{5x^2 - \sqrt{x} - 9}{120x - 3x^2} \)

B. Let \( f(x) = \begin{cases} 
2x & \text{if } x < 0 \\
1 & \text{if } x = 0 \\
x^2 & \text{if } x > 0 
\end{cases} \). For each of the following, find the limit. If the limit does not exist, say so; use \( \infty \) and \( -\infty \) when appropriate.

(i) \( \lim_{x \to 0^+} f(x) \)

(ii) \( \lim_{x \to 0^-} f(x) \)

(iii) \( \lim_{x \to 0} f(x) \)

(iv) \( \lim_{x \to \infty} f(x) \)

Problem 2 (25 Points)

(a) Use the definition of the derivative to find \( f'(2) \) for the function \( f(x) = 5x - 3 \).

(b) Find the equation of the line tangent to the graph of \( y = \left(\frac{2x^2}{1+x}\right)^4 \) at the point (1, 1).

(c) Find all points on the graph of \( y = x^3 - 3x^2 + 1 \) where the slope is 0.
Problem 3 (25 Points) 
(a) Find all value(s) of $x$ for which the following function is **discontinuous**.
\[
  f(x) = \begin{cases} 
    1 & \text{if } x < 0 \\
    -1 & \text{if } x = 0 \\
    x^2 & \text{if } x > 0 
  \end{cases}
\]

(b) The average cost $\bar{c}$ of producing $q$ units of a product is given by $\bar{c} = \frac{4q}{q + 2} + \frac{10000}{q}$. Find the marginal cost function.

(c) For the consumption function $C = 10 + \frac{5}{8}I - \frac{\sqrt{I}}{2}$,
   a. find the marginal propensity to consume when $I = 16$;
   b. find the marginal propensity to save when $I = 16$.

Problem 4 (25 Points):
(a) Find the derivative of $y = (x^2 + 9)\sqrt{x^3 + 4}$ at $x = 0$.

(b) If $y = u^3 + u^2 + 7u - 2$ and $u = 5x - 6$, find $\frac{dy}{dx}$ when $x = 1$.

(c) Find the rate of change in the area of a circle with respect to the radius when the radius is 2 inches. Also find the relative rate of change in the area. ($A = \pi r^2$)