

Problem 1: Consider the function $f(x) = 3 - \frac{2x}{x^2 - x}$.

(a) If it exists, find the limit. If it does not exist, show why. Use the symbols ∞ or $-\infty$ as appropriate.

(i) $\lim_{x \rightarrow 0} f(x)$

(ii) $\lim_{x \rightarrow 1^+} f(x)$

(iii) $\lim_{x \rightarrow \infty} f(x)$

(b) Find all values of x at which $f(x)$ is discontinuous.

Problem 2:

(1) Find the slope of the line tangent to the graph of $f(x) = \frac{1+x^2}{\sqrt{x}} + 3p^2$ at $x = 4$.

(2) Find all values of C which will make the following function continuous.

$$f(x) = \begin{cases} C - 2x & \text{if } x \leq 2, \\ x^2 - 3C & \text{if } x > 2. \end{cases}$$

(3) Use the definition of the derivative to find $f'(2)$ where $f(x) = 1 - x^2$.

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Problem 2:

(1) Find the slope of the line tangent to the graph of $f(x) = x\sqrt[3]{x} + 2e^3$ at $x = 8$.

(2) Find all values of C which will make the following function continuous.

$$f(x) = \begin{cases} C - 2x & \text{if } x > 3, \\ x^2 - 2C & \text{if } x \leq 3. \end{cases}$$

(3) Use the definition of the derivative to find $f'(3)$ where $f(x) = \sqrt{x}$.