1. No books, notes, calculators or cell phones are allowed.

2. Show your work in details.

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1. (20 pts)

(a) Find the domain of the function

\[ f(x) = \sqrt{\frac{x - 2}{x + 3}} \]

(b) Let \( g(x) = f(\tan x) \). Find \( g'(\pi/4) \) if \( f(1) = 2 \) and \( f'(1) = 3 \).

(c) Find horizontal and vertical asymptotes of \( f(x) = \frac{1 + 3x}{x + 1} \). Justify your answer.
2. (20 pts) Evaluate the limit or explain why the limit does not exist:

(a) \[ \lim_{x \to 2^+} \frac{4 - x^2}{\sqrt{x^4 - 16}}. \]

(b) \[ \lim_{x \to -\infty} \frac{\sin x}{x}. \]

(c) \[ \lim_{x \to 0} \frac{\sin(3x)}{\sin(-2x)}. \]
3. (20 pts) Find all possible values of $a$ and $b$ so that the function

$$f(x) = \begin{cases} 
  x + 2b, & x < 3 \\
  bx^2 - a, & x \geq 3
\end{cases}$$

is differentiable everywhere on $(-\infty, \infty)$. Justify your answer.
4. (20 pts) Consider the function \( y = f(x) = \sqrt{4x + 1} \).

(a) Use the definition of the derivative to find \( f'(x) \) and state the domain for \( f \) and \( f' \). NOTE: No marks will be given if the definition is not used.

(b) Find an equation of the tangent line to the graph of \( f \) at the point \((a, f(a))\) where \( a = 2 \).
5. (20 pts) Calculate each of the following; you do not need to simplify your answer.

(a) \( f'(x) \) if \( f(x) = \csc(\cot(x^4)) \).

(b) \( g''(x) \) if \( g(x) = \frac{4x+2}{5x-2} \).

(c) \( h'(x) \) if \( h(x) = e^{4x^2} \sqrt{x^2 + 5} \).