

Duration: 50 minutes

Instructions: Answer all questions, without the use of notes, books or calculators. Partial credit will be awarded for correct work, unless otherwise specified. The total number of points is 100.

1. (20 points: 10 points each) Compute the derivative of the following functions.

(a) $\sqrt{x^2 + 1}$

(b) $\sin(x^2) \cos x$

2. (20 points) Let $g(x) = x^3 - 2x + 1$.

(a) (8 points) Find the slope of the tangent line of $y = g(x)$ passing through the point $P(2, 5)$.

(b) (7 points) Find the equation for the tangent line whose slope you found in (a). (If you cannot solve part (a), pretend that the answer is -1000 .)

(c) (5 points) Where does the line found in (b) intersect the x -axis?

3. (20 points: 10 each) Find the following limits if they exist, either as numbers or $\pm\infty$. If a limit does not exist, explain why not.

(a) $\lim_{x \rightarrow 5^-} \frac{x^2 - 4x - 5}{x^2 - 3x - 10}$

(b) $\lim_{x \rightarrow 4^+} \frac{x + 4}{x - 4}$

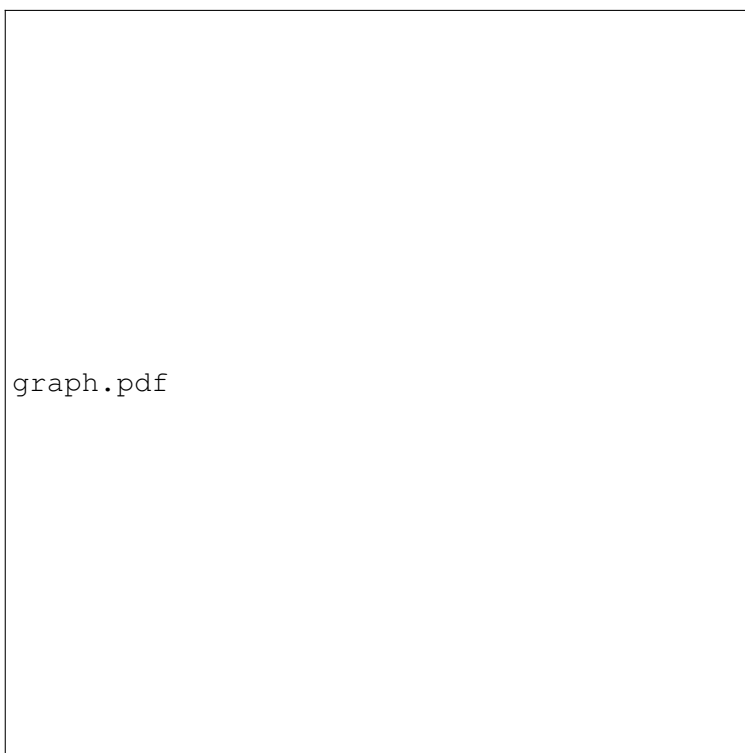
4. (20 points) Consider the following piecewise defined function:

$$f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & x \neq 0 \\ 0 & x = 0 \end{cases}$$

(a) (12 points) Use the definition of the derivative to find $f'(0)$.

(b) (8 points) Is $f(x)$ continuous on $(-\infty, +\infty)$? Explain your reasoning.

5. (20 points)



Carefully sketch the derivative of $h(x)$ on $0 \leq x \leq 4$ given graph of $h(x)$ to the left. Be sure that your coordinate axes are correctly labeled.