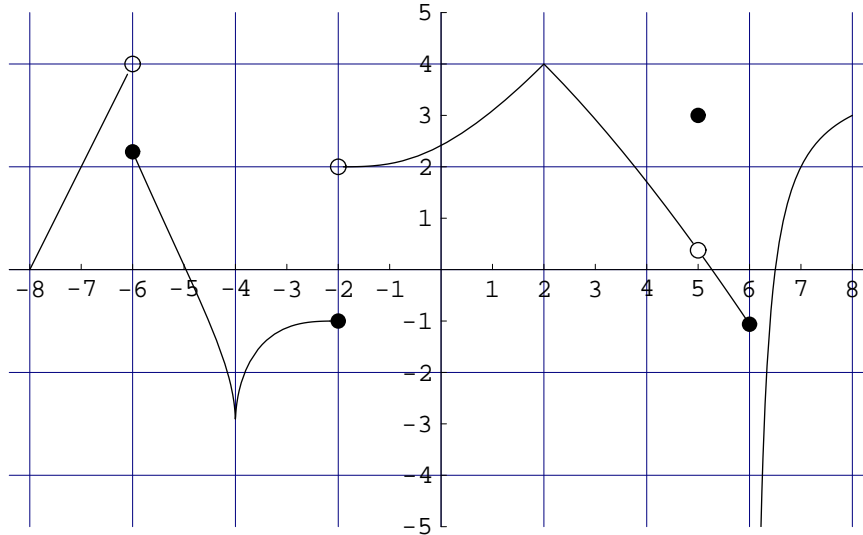


1. (1 point) True or false: I hate limits which contain square roots.

2. (5 points/part; total 20 points.) For the function $y = w(x)$ graphed below, answer the following questions:



(a) List all numbers a in $(-8, 8)$ such that $\lim_{x \rightarrow a} w(x)$ does not exist.

(b) Find the largest interval containing -3 on which w is continuous.

(c) List all numbers a in $(-8, 8)$ such that w is not differentiable at a . Give reasons.

(d) Which of the following best describes $w'(4)$?

- (1) $w'(4)$ does not exist.
- (2) $w'(4)$ is close to 0.
- (3) $w'(4)$ is positive and not close to 0.
- (4) $w'(4)$ is negative and not close to 0.

3. (10 points.) Let f be a function such that $f'(x) = 2e^{-x^2} + \sqrt{7}$. Find the derivative of the function $g(x) = \frac{x}{f(x)}$. (Your answer might involve the function f . You need not do this directly from the definition.)

4. (7 points) Let f and g be functions which are differentiable at -2 and which satisfy

$$f(-2) = -5, \quad f'(-2) = -3, \quad g(-2) = 4, \quad \text{and} \quad g'(-2) = 2.$$

Let $w(x) = x - f(x)g(x)$ for all x . Find $w'(-2)$.

5. (a) (7 points.) State carefully the definition of the derivative of a function.

(b) (13 points.) If $f(x) = \frac{1}{x+4}$, compute the derivative $f'(3)$ *directly from the definition*. (You should check your answer using the differentiation formula, but no credit will be given for just using the formula.)

6. (10 points/part) Find the exact values of the following limits (possibly including ∞ or $-\infty$), or explain why they do not exist or there is not enough information to evaluate them.

(a) $\lim_{x \rightarrow 3} \frac{\sqrt{x} - \sqrt{3}}{x - 3}$.

(b) $\lim_{x \rightarrow \infty} \frac{4x^2 + 6070x + 193}{17x^2 - 9x + 21}$.

(c) $\lim_{x \rightarrow 4^-} \frac{f(x)}{x - 4}$, given that $\lim_{x \rightarrow 4} f(x) = 9$.

7. (12 points) Let c be a positive constant. Find the equation of the tangent line to the graph of $f(x) = e^x + cx$ at $x = 3$. (Use exact values in your answer—no calculator approximations.) You need not calculate the derivative directly from the definition.

Extra credit. (Do not attempt these problems until you have done and checked your answer to all the ordinary problems on this exam. They will only be counted if you get a grade of B or better on the main part of this exam.)

EC1. (8 extra credit points) Let $f(x) = e^{2x}$. Using only the differentiation rules in Sections 3.1 and 3.2 of the book (the ones we have done so far), find $f'(x)$. (You might want to check your answer using the chain rule, if you have read that far in the book. However, no credit will be given for a calculation that uses any form of the chain rule in any step.)

EC2. (15 extra credit points) Give a convincing argument to show that the function $f(x) = e^{4x} + x + 2$ has an inverse whose domain is the entire real line. (Don't use calculator graphs.)